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DEPARTMENT OF AGRICULTURE.

BULLETIN No. 97.

THE MANAGEMENT OF GREENHOUSES,

BY

EDWIN LONSDALE.

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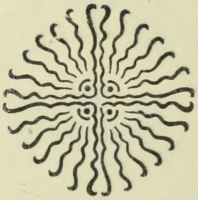

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PREFACE.

Harrisburg, Pa., August 1, 1902.

The following Bulletin No. 97, upon "The Management of Greenhouses," by Edwin Lonsdale, of Wyndmoor, Pa., will commend itself as being worthy of the attention of florists and greenhouse managers everywhere in the Northern States.

Mr. Lonsdale has had large experience in this work, and was chosen for the preparation of a bulletin upon Greenhouse Management because of his success in this direction, and his eminent fitness for the discussion of the difficult questions which confront the grower of flowers and ornamental plants, whether for home adornment or for the general market.

Few men in the midst of active business, as is Mr. Lonsdale, are willing to take the time to write out their experience, in readable form for public use, and all who are interested in floriculture, or in the cultivation of decorative plants, can, therefore, well be thankful that the author has sacrificed, for their benefit, his hours needed for rest and recuperation.

JOHN HAMILTON,
Secretary of Agriculture.

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LETTER OF TRANSMITTAL.

Wyndmoor, near Chestnut Hill, Pa.

Hon. John Hamilton, *Secretary of Agriculture*, *Harrisburg*, *Pa.:*

Dear Sir: Acting according to your request received some time ago to prepare a pamphlet on "The Management of Greenhouses," same is herewith submitted.

While greenhouses for the growing of a general collection of plants have long been in use, the industry for the exclusive use of greenhouses for the growing of cut flowers, especially for winter, is of comparative recent development, dating back not much more than twenty-five years in Pennsylvania.

In the spring of 1880, an establishment was started near Philadelphia—modest in its proportions, it is true—in which to grow cut flowers to be disposed of under wholesale arrangements. There were three greenhouses, each one hundred feet long. The one for roses was twenty-three feet wide. In that house were grown five varieties, namely: Safrano, Isabella Sprunt, Bon Silene, Niphetos and Perle des Jardins, none of which are grown in any quantity for winter blooming at the present time in or near to the larger cities. Another house was for Carnations, and the variety grown was principally, King of the Crimsons. This variety found ready sale on account of its color to help out the celebrated crimson rose, General Jacqueminot ("Jack"), which was at the height of its popularity about that time. The third house was devoted entirely to Smilax, so called, by florists, botanically known at that time as *Myrsiphyllum asparagoides*; now, according to Bailey it is classified as an *Asparagus*, *A. medeoloides*. At this time little or no other green was grown to associate with flowers, excepting, possibly, Maidenhair Fern—*Adiantum cuneatum*—and that in very limited quantity. This house contained about 3,500 plants, which proved at that time to be more than Philadelphia could use to advantage. Florists in the cities of New York and Washington, however, were only too glad to take the surplus, and for several years, florists of the two cities named depended largely upon this establishment for much of their Smilax supply. Smilax was at that time an excellent paying crop, frequently yielding one dollar per square foot, which is considered very profitable.

Other greens have come since that time which are more popular than the older Smilax, as *Asparagus plumosus nanus, and A. Sprengerii*, the former of which twines itself on strings as does the Smilax, and houses very high are built especially for its cultivation; whereas, *Sprengerii* grows in plumes or sprays and are cut in lengths from nine to eighteen inches, and are sold in bundles of about twelve plumes each, averaging about fifty cents per bunch.

Asparagus tenuissimus, known to some extent as "Mermaid's Hair," was the first to dispute the position occupied for so long by Smilax, but for some reason it seems to have entirely gone out of cultivation, especially about the larger cities. According to Bailey, *tenuissimus* is a variety of *plumosus nanus;* which would never be suspected by the casual observer. Mermaid's Hair, describes it very well, being very finely cut indeed, resembling greenish mist.

Another green grown is the *Adiantum Farleyense*, the Queen of Maidenhair Ferns, and it richly deserves that name. No fern, however, at present in commerce, is so well suited to go with flowers as are the different varieties of Aspargus on account of the tendency to wilt so soon. There is, however, a new Adiantum (Maidenhair Fern) to be sent out soon which is similar to *Adiantum cuneatum*, which is far superior to any other in its lasting qualities after being cut, and for that reason when it becomes better known must become popular.

The general principles laid down in the following pages for the guidance of those who have a desire to embark in the greenhouse business will, I hope, be found to be helpful.

Respectfully submitted,
EDWIN LONSDALE.

THE MANAGEMENT OF GREENHOUSES.

By Edwin Lonsdale, *Wyndmoor, Pa.*

It can hardily be questioned, I believe, that the growing of plants in the window was the fore-runner of the greenhouse structures of to-day, in which to shelter exotic and other tender plants from frost and to force flowering plants into bloom out of their natural season. Great improvements have been made in the building of greenhouses during the past twenty-five years; especially does this apply when used in floriculture and the growing of plants for decorative purposes, which come under the head of ornamental horticulture.

The first greenhouse built would, it is natural to suppose, be an attachment to a residence, and in those early days what are termed "lean-to's" were the most generally in use. The term "lean-to" means that the wall, which was a part of the residence, upon which the greenhouse appeared to lean was utilized as one side of the structure, and the sash-bars were secured at the top to the house side and at the lower end to a wall low enough to give the necessary angle to allow rain and snow to fall naturally therefrom, and at the same time to give the sun an opportunity to reflect his life-giving rays therein. And the methods employed in these days also are to build greenhouses to catch every possible sun-ray, that is to say, when such a structure is erected for the purpose of producing flowers in the more or less frosty nights and cloudy days of winter, with some exceptions, which will be noted in due course.

The variety in styles of greenhouses now in use is almost infinite. Indeed each individual has his own ideas which he has naturally embodied into a plant-growing structure.

To advert for a moment to growing plants under glass, flowering plants are especially in mind. Among the most popular flowering plants for cut flower purposes to-day that are hardy, or very nearly so, we note here.

We will place the Rose first, and with very slight protection from severe frost, all the popular varities used in the winter season are, speaking generally, hardy. It is also true to a great extent with the Carnation and the Chrysanthemum; and in the Lily of the Valley it is quite true as to its thorough hardiness, and which, by the way, may be had in flower, if due notice is given, on any day at any time of the year. This is brought about by a systematic arrangement with cold storage, in which to keep the roots dormant until the proper time.

We have the exotic Orchids for cut flowers, but Roses are really the most popular flowers before the public at the present time, and observers of events feel they can safely say that the Rose, the "Queen of Flowers," will for all time hold the affections of the people. To the laymen, if I may be allowed to so designate those who are not in close touch with the forcing of Roses for cut flowers commercially, it may seem strange when I say that out of hundreds of varieties and species of Roses in and out of catalogues and books of reference, there are less than a dozen which are recognized as being both profitable and popular for the purpose indicated.

As to varieties, American Beauty stands first on the list. Its cerise color is too well known to need anything more than a passing mention here. Its sweet June Rose scent endears it to all, besides being a Rose which when well grown may be cut with almost any length of stem desirable. For special purposes, flowers with stems eight feet long have been cut—these are the most expensive of any; not that the individual flower is any better on these extremely long stems than on shorter ones, because they are not. Frequently the flowers on a stem a foot long or even shorter will be equally as perfect in form, size, color, and, of course, fragrance, as those with a much longer stem. It is the scarcity of these very long stemmed flowers, and the special uses to which they may be put, which makes them more valuable and consequently higher in price than the shorter ones. This Rose may be bought all the way from one dollar to twenty-five dollars per dozen, according to the season of the year and the length of stem and quality of the flower, but the fragrance, bear in mind, may always be found in the flower no matter how long or how short the stem or how far from perfect may be the flower in form.

The origin of American Beauty Rose is in doubt. A claim is made that it was discovered in the garden of the late historian, George Bancroft, at Washington, D. C., who was a great lover of Roses and had a collection of numerous and choice varieties. It was the gardener of Mr. Bancroft who discovered it first, but whether he thought he could see that it possessed a possible forcing quality or whether by accident it was found out, has not to my knowledge been placed on record. Certain it is that more area under glass is devoted to its culture for the large cities, as Philadelphia, New York, Chicago and Boston, than all the other varieties of winter forcing varieties combined.

Although we owe much to the florists of Boston for having been the pioneers in the development of Rose forcing in general, yet the

American Beauty, for some unaccountable reason, has not in the past been grown thereabouts entirely successfully until the past year or two when better reports have been recorded; consequently the Boston retail florists have been depending upon the Rose growers about Philadelphia and some other localities for the greater part of their supply therefor. There are evidences, however, that many more of the flowers of the American Beauty will be home grown for the Boston supply in the future than there has been in the past, for some immense structures have been built near to that city for the purpose indicated during the past year or two. Rose houses 750 feet long and 25 feet wide have been built within the past two years, in which, we believe, only American Beauty Roses are grown.*

When the American Beauty received so much attention in the American horticultural magazines, the European horticulturists naturally became interested, and, in consequence ,ordered plants of same. In due course these plants flowered, and thereupon a French nurseryman recognized in it an old variety by the name of Mme. Ferdinand Jamin, and duly spread the information broadcast in all languages where advanced horticulture is known. This, as a consequence, temporarily at least, gave American nurserymen a bad name—that of renaming an old variety and redisseminating the same, thus causing much confusion in Rose nomenclature, besides placing American disseminators of floricultural novelties under the ban. In the case under consideration it was purely unintentional. Besides, if it is in any way consoling, the European distributors of novelties have been guilty of the same kind of "slips"—that of renaming and redisseminating old European varieties under new American names.

It would be interesting to learn the pedigree of the Rose under consideration, but am afraid it is beyond our efforts to secure same. As a digression, will state here, though in all probability, generally known, that in the vegetable kingdom there is cause and effect in the production of seed, that is to say, the farinaceous-like substance on the stamens must be applied to the pistils of the flowers before seed is produced, then, when given the proper opportunity, Mother Earth does the rest.

An old friend of mine, fifteen years ago, in the columns of the American Florist, made the statement that American Beauty was the best Rose introduced for the past twenty years, and although he was ridiculed to some extent at the time, nothing but the truth was stated as time has proven. The grand blooms of this Rose that have been produced since were not dreamed of at the time the statement was made, but the improved methods of culture and a more exacting demand as to quality for all classes of flowers has helped along the good work.

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* In Connecticut during the present Summer (1902), a rose house 800 feet long by 50 feet wide was built, in which are now growing American Beauty for the Boston market.

From the American Beauty Rose has sprung two varieties, namely: "American Belle" and the "Queen of Edgely." Both originated as what are known among gardeners and florists as "sports," that is to say, a shoot produced a flower that was distinct from those produced by the parent plant. Cuttings, "slips" or scions were made from said shoot, and in due course plants resulted therefrom and flowers produced which proved to be sufficiently distinct to warrant the adopting a different name. The color of the flowers of both sports, or, as Darwin would call them, "bud variations," were nearly alike, being pink and very much lighter in color than those produced on the original American Beauty, though the general habits of the respective sports were very different.

The Queen of Edgely is similar to "Beauty" in all respects excepting the color of the flowers, whereas in "Belle" there is a decided difference, which is noticeable at a glance; the leaves are smaller and the variety is less vigorous than either of the other two, consequently more difficult to manage, and that is why the American Belle has never become popular with the growers of cut flowers for market. Many experts believe that had it possessed the strong vigor of either its parent or its sister-sport, the Queen of Edgely, it would have been grown in almost as large quantities as is the American Beauty now grown and the "Queen" is expected to be grown. The latter was only introduced to general cultivation during the spring of 1901, whereas, the American Belle was disseminated in 1893. Both the American Belle and Queen of Edgely originated in Pennsylvania; the former, near Chestnut Hill, in Montgomery county, and the latter, near Bristol, Bucks county.

Other varieties of roses which have found favor with both flower buyers and the growers of roses, are the Tea-scented roses, Bridesmaid pink and the white one, Bride; and, strange as it may appear, both these originated as sports and both from the same source, namely ,from a rose sent out from France in 1869, named Mlle. Catherine Mermet, which has been almost entirely superseded by its offspring, Bridesmaid, being a brighter pink and more constant in its coloring. Two other varieties sported from "Mermet," namely, "Waban" and "Maid of Honor," both a darker pink in color than the original and more flat in form, neither of which became popular. The Bride appeared in 1885, and Bridesmaid in 1892, both in New Jersey; Waban appearing in Massachusetts and Maid of Honor in Ohio.

"Golden Gate" is of American origin, and is another very satisfactory rose to grow, having a strong constitution and produces its beautiful buds plentifully. Its name is a misnomer, however, being neither yellow in color, nor did it originate near to the Golden Gate in California, but was raised from seed about the year 1890 by a Mr. Little, of New Orleans, La. In color it is creamy white, with a suggestion of yellow at the base, delicately tinted at the edges of the petals with pink. This variety has also sported a white form, to be known as "Ivory." Its real value generally is not at present known as it is not yet in general cultivation. It will be sent out during the present year (1902). It, however, is full of promise.

The "General Jacqueminot"—"Jack"—is not so much grown for winter blooming as it at one time was, being a one crop rose, and in order to try to keep up a continuous supply, several houses had to be grown of it and started at intervals of two weeks or so with that object in view. "Meteor," being crimson in color and everblooming in character, has largely taken its place. It is, however, not so good a rose as the older favorite in any way, excepting in its perpetual blooming qualities. It has little or no fragrance, and it is not so large nor so good in form, nor is it so pleasing in its crimson coloring. This rose was raised from seed in England. A newer crimson-colored variety, known as "Liberty," was distributed for general cultivation during 1900, which is very much superior to Meteor in every way, excepting that it is not such an easy doer, being more difficult to manage, but is giving excellent results with some growers. Liberty was a seedling raised in Ireland.

"Perle des Jardins," a yellow tea-scented rose of French origin, was sent out in 1874, and for a number of years was very popular, leading all others for a few seasons and entirely superseding "Marechal Niel," a yellow rose blooming in crops with rampant growing tendencies, so much so that special houses were built in which to develop its peculiarities. Although the "Niel" was a large flower and a beautiful shade of yellow, the very short stems upon which the blooms appear would debar it on social and general occasions in these days of long, stout and erect stemmed roses, and would find little or no favor now, excepting possibly on special occasions.

From the "Perle" quite a number of sports have originated. The first was "Sunset," which appeared near to Jersey City, N. J., about the year 1880, and was a fawn shade of yellow in color, and the leaves on the young growth took upon itself a more reddish tinge than appears on the older Perle. This also became quite popular. "Senator McNaughton," a creamy white in color, originated in Philadelphia, but was not grown to any extent because it was not nearly so good in any way, save possibly in its free blooming qualities, as is the most popular white rose to this day for winter blooming ever introduced, namely, the Bride. Another sport came from Canada, but this I am inclined to think sported from Sunset, and was called Lady Dorothea; the coloring was more intense in the latter than the former. Pink Perle and White Perle were announced from Kentucky, but neither made any impression upon the trade for cut flowers. "Sunrise" was one of the novelties among roses last year (1901). It is a European production and is very beautiful. It may be a sport from Sunset, as it has the same general habit as that variety, both in foliage and coloring of the flowers, but very much intensified. This variety has also sported. It perhaps would be safest to say, reverted, for so far the flowers produced on the sported branch are apparently identical with Perle des Jardins.

"Mme. Cusin," another French Rose, had a few seasons of popularity. It is a delicate shade of pink in color, beautiful in shade and form, though somewhat flat, and in its lasting qualities after being cut from the plant, it is far superior to all others. This also sported in New Jersey, and the resultant variety is known as "Mrs. J. Pierpont Morgan." The color of the flower is much darker, being a bright, though light shade of solferino; the flower is also larger than "Cusin," and its good keeping qualities are, if possible, even better. And "Mrs. Morgan" has recently sported in Massachusetts, this time to an exquisite shade of delicate pink. It has been named "Mrs. Oliver Ames," and will be disseminated for general cultivation during the present year (1902).

All roses may be forced into bloom out of their natural season, provided proper care is taken in the preparation of the plants and the subsequent care of same; but those named are the most popular and easier to manage than are the hundreds to be found in catalogues and books of reference. The tea-scented section and the Hybrid Tea, because naturally everblooming, are the easiest to manage in this respect, and need little or no preparation excepting to give them generous treatment so that they may be kept growing; but all the buds and blooms should be kept pinched off during spring and summer, without taking any part of the shoots excepting one eye and leaf possibly with the flowers. We have thought it best to allow the flowers to come into full bloom before they are removed, because the shoots which are left on the plants seem to break into growth much quicker than when pinched off in the small bud state.

Before closing these rose notes, I must say that the old favorites of twenty-five years ago, as Bon Silene, pink in color, Safrano, fawn color, Isabella Sprunt, yellow—a sport from Safrano— and Papa Gontier, dark pink, are all really easier to manage than are the Bride and Bridesmaid, but the flowers are considered too small for present general requirements.

Roses for cut flowers, whether grown by the trade for sale or by amateurs, are grown in soil on tables or solid beds, as taking less care than when grown in pots, though just as good flowers may be grown in pots as in any other way, but they require very much greater care in order to produce the finest flowers. American Beauty may be an exception to that rule, because the long stems required of this rose for the best and most exacting trade could not be produced in pots in sufficient quantity to pay.

It has been deemed advisable to thus treat upon roses at length, because if roses can be grown successfully in greenhouses, the operator thereof need not hesitate to undertake to grow any other plant, as roses are among the most difficult plants to grow and bloom successfully that we have.

The question of temperature in the growing of roses is one of the most important, and nearly all the sections mentioned need a few degrees difference at night if we would achieve the greatest success. For instance we have found the Meteor must have five degrees higher at night, namely, 65 to 68 degrees, than American Beauty, Queen of Edgely and American Belle require, which to do their very best should have from 60 to 62 degrees; kept as nearly the first named number of degrees as possible is the better. Bride and Bridesmaid, 56 to 58 degrees, and Bon Silene, Safrano, Isabella Sprunt and Papa Gontier, 54 to 56 degrees, and Golden Gate, 58 to 60 degrees. Perle, Sunset and Sunrise, from 60 to 62 degrees.

And a similar state of affairs exists with Carnations, though not quite to the same extent. Twenty-five years ago, from 40 to 45 degrees was considered about right for these popular flowers, but it is found now that for best results with the greatly improved varieties now being grown, a temperature about the same as that recommended and in use for roses at the same period is now in use for Carnations, namely, about 55 degrees.

New varieties of Carnations are so readily raised, and are being raised in all parts of the country, that it is quite difficult to keep track of them all. One, named "Prosperity," should be mentioned, however, because it is such a decided step forward that it seems today that it will be some time before it is distanced. This was sent out last year. It produces the largest flower of any variety in commerce, with stiff, erect and long stems, and is white, marbled with pink, in color.

A scarlet variety, named "Adonis," should be mentioned also, as it is one of those superior varieties that looms up head and shoulders above all the rest and looks as though it had come to stay for awhile. It is brilliant scarlet in color, of large size, and has the necessary stout and erect stem. The raiser of this novelty lives in Ohio, and has sold same to two firms jointly, one living in Indiana and the other in Philadelphia. The purchase price for control of the stock is said to have been $5,000. It will not be put into commerce until the spring of 1903.

The price just named does not begin to compare with the price which is said to have been paid by Thomas W. Lawson, of Massachusetts, for the variety which was named "Mrs. Thomas W. Lawson," after the Copper King's wife. Said price was $30,000, but so well was the variety advertised and so many plants had been sold that the purchase money was reported to have been returned by the end of the month of February, when there were still remaining three good months in which to sell this sterling novelty. It has proven to be a grand variety, giving excellent results generally, which is more than can be said for every new Carnation that is disseminated, many varieties being absolute failures in some sections of the country; whether it is the soil, the climate, or the water, which does not suit them has not yet been determined.

VENTILATION.

One of the most important matters in connection with the successful management of the greenhouse is the ventilation. It is very necessary, not only to keep the temperature within down to the mark, but it is also necessary in order to make as complete a change of the inner atmosphere as is possible.

In the olden time when greenhouses were frequently, we may say, generally built with sashes made for the purpose, the mode of ventilation was to slide them all down from the top, or as many of them as were left loose for that purpose, or according to the weather, and with the pipes for heating purposes arranged beneath the stages, thus a thorough circulation was made and the air changed.

Nowadays, however, few greenhouses are built with sashes, but instead, by what is known as a fixed roof, and arrangements are made whereby sashes are hinged at the apex and lifted by a machine made for the purpose, and by which the temperature may be regulated to a nicety.

There is an automatic ventilating apparatus on the market, which works with complete accuracy. It is operated by water pressure, but it cannot be operated satisfactorily unless there is guaranteed water pressure under control of not less than twenty-five pounds. This is a wonderful contrivance, and is a great labor-saving machine. Its cost, however, may seem to some prohibitory.

THE WATER SUPPLY.

The water supply is one of the first and most important matters to be considered in the starting of a greenhouse.

Not more than twenty years ago, even within city limits, cisterns were built inside the greenhouses in which to catch the rain-water which fell upon the roof, and many old-time gardeners to-day prefer the water secured in that way to any other for the purpose indicated, as they claim it is more soft and richer in the essential plant-foods than is found in the water in general use, as from springs or wells or from water companies. There is no doubt as to the truth of this matter, but only in a very small greenhouse is such a method practicable. A cistern is sometimes used in conjunction with a more complete water supply, the water from which is held in reserve for special purposes for some plants.

A never failing supply is what must be secured or the results might prove disastrous. Out in the country, away from a regular water supply furnished by a company or municipality, a drilled or a driven well or a never failing spring or creek with a windmill or some other motive power whereby the water could be lifted to a raised tank or to a point on higher ground should be secured. The higher the tank or whatever the storage method may be the better, if the expense is not too great, because a greater pressure to aid in distributing the water is secured thereby; and a heavy water pressure is advantageous in the hands of a careful person watering the plants, because it aids in getting the watering done more quickly when haste is not a detriment. In the hands of a careless operator a high pressure is sometimes a disadvantage, because more water is likely to be given oftentimes to the plants than is good for them when said plants cannot use same to advantage, as during dark, cloudy or rainy weather or in a low temperature. A careful man will, however, regulate the water supply at the spigot by turning same on only half or even less as the necessity of occasion requires. A strong pressure is a boon in any greenhouse on a bright, warm day, when the water may be given freely, both at root and on branch, and many insects which are among the banes of plant life under glass are kept in check by the judicious use of a powerful force of water; this applies especially to what is known as the red spider, which will be treated under the head of insects, later.

A windmill was referred to as a good power to bring into use to lift the water to an elevation, but when this is used the storage capacity should be large enough for at least a two weeks' supply, though a two weeks' supply is very indefinite. As a guide, for a greenhouse 100 feet by 20 feet, 500 gallons a day on the average should be ample. It is surprising how much water our plants seem to need when the wind does not blow. In the months of August and September, we have very often noticed the wind is frequently not found working quite so faithfully as we would like it to do.

Other motive powers for pumping water besides wind, are steam and the various hot air engines, but the best water supply of all is, when obtainable, through some public works, as a municipality, borough, township, or by a private company.

The vast importance of the water supply will be realized when it has to be carried some distance on a bright, hot day. Personally, I have carried water from a little brook, a pailful in each hand, fifty feet from the nearest point to the entrance to the first of four greenhouses one hundred feet long. That process of watering appears tedious and very hard work now in the light of our present up-to-date hose in hand operations. At another place I have dipped water out of a cistern until same was empty, when we had to carry it from a pond two hundred feet away, and in hot, dry weather as soon as we had finished watering the plants at one end of the greenhouses we had to begin and go all over them again, so much water did the large plants need. It is frequently necessary in hot,dry summer weather to water plants twice a day.

In some large establishments arrangements are made whereby the water is heated in the winter-time, to a temperature of 65 to 70 degrees, but when pumped direct from a well where the water is 56 degrees there is no necessity for the water to be heated. And the advisability of heating water before using on the plants has frequently been questioned, because the atmosphere in the greenhouse should be at least 70 degrees before watering over the leaves of the plants is undertaken, and under those conditions the water would be in a very few minutes the same temperature as is the atmosphere therein.

DRAINAGE.

After the water question has been disposed of, drainage next suggests itself, and it is equally as important in greenhouse operations as it is upon the farm.

When solid beds are used in which to plant, or on a table or in a flower pot, it matters not which, we must feel reasonably certain that the drainage is ample. There is more necessity to look into this matter with some soils than there is in others; for instance, a clay soil will require more care in that respect than will that having a more porous character.

Some florists think they are gaining an advantage by using drain-tiles so close together beneath the beds as to touch each other. The manner in which this particular plan is carried out is as follows: First, the inside of the greenhouse in which this style of a drained bed is to be built must be carefully graded, not necessarily perfectly level, but on a uniform grade. The walks or alley-ways should be laid out at convenient intervals, and after the bed has been thoroughly firmed to avoid as far as possible the liability to settling, the drain-tiles are arranged across the bed, the open ends of the tiles to present a straight line and to remain open at the outer edge of what will be the bed proper and define the line of the walk.

When sole-tiles are used it is deemed advisable to place same with the sole side or bottom upward, which will thus present a better surface for shoveling, because more level, when the old soil is removed preparatory to bringing in fresh soil and new plants. When it is decided that the tiles are to be arranged with the soles upward, it will be found necessary, after the base of the bed has been made thoroughly firm, to scatter sand thereon or the finer particles of screened ashes or similar loose material in which to place the tiles to hold them in position until the job is completed.

A wall is then built six, eight or ten inches high, the base resting upon the ends of the drain tiles, said tiles to remain open as before advised; in this way complete drainage is not only secured, but what is believed to be of equal importance, the free passage of air through the drain-tiles will counteract the possibility of sourness in the soil, thus going a long way toward insuring the well doing of the plants growing thereon.

The wall may be either of bricks, single, thick or concrete. Many retaining walls for solid beds are now being built with the last named material, which may be composed of coal ashes, gravel, sand and cement in proper proportions. Coal ashes are generally quite plentiful about a florist's establishment after he has started a short time, and I know of no better use to put them to than by building just such walls as above referred to, and as there are likely to be more of them in use in the future than there has been in the past, a few hints as to their construction will not be out of place at this time. Here is what the writer hereof prepared for the columns of the American Florist a few years ago:

"It is ten or twelve years since I first commenced to experiment in making walls with concrete. My first efforts were made with iron ore sand (refuse from the iron mines) and cement, but this became rather too expensive, on account of the long and heavy haul in addition to the first cost of the material. Sand of all kinds in this part of the country is scarce. In 1892 it occurred to me that if we could use coal ashes as a base for this purpose how much cheaper and convenient it would be. (Our brethren in the natural gas belt may or may not appreciate that statement.) I made known my thoughts to a friend in the profession, in whose judgment I had explicit faith, and he said "It won't do, my boy, the acid in the ashes will destroy the effectiveness of the cement." This certainly was a stunner, and I cannot now recall how I overcame the effects of it and ventured to make the experiment with the tabooed material, but I summoned up sufficient courage to do so, and we now have six of our greenhouses fitted up with walls of this kind, and they are apparently all right up to the present writing.

"We have never used any other but ashes from hard coal—anthracite—but believe the ashes from soft or bituminous coal could be used with almost if not quite as satisfactory results. The greatest trouble we find is in preparing the boards into which the materials, when properly mixed and ready for use, are deposited in order to make the wall. If we would have a straight and mechanical looking job when completed, the boards must be braced thoroughly by driving in stout stakes alongside at frequent intervals and then nailed together temporarily though securely at the top to keep them from spreading, which they surely will do when the wet and heavy concrete is shoveled inside the casings. There would be much saving of labor if two-inch or three-inch planks were used instead of inch-thick boards to form the frame work into which the material is dumped, because they would remain in position better and with fewer stakes.

"Not until all the moulds, as we may term them, in which the walls are to be cast are ready should the concrete be mixed, and then only such a quantity as can be used in half an hour. When, as above indicated, everything is quite ready to begin operations, we have a board or rather a number of boards nailed together, eight or ten feet square, with the joints as tight as it is possible to make them, or some of the cement will wash through with the water, and we proceed to mix the ashes and cement together, taking six or seven parts of the former to one of the latter, of which we find the better brands of Portland cement the most economical. These materials should be thoroughly mixed by turning three or four times, and should be done while they are quite dry, before any water is applied at all, after which water may be brought into use, and when every particle is thoroughly moist without being too wet it is ready to be applied to where the walls are to be built, and with reasonable activity, with enough men employed who can be used to advantage without being in each other's way, this part of the operation is a short one, "The concrete should be pounded with a rammer gently though sufficiently until it has filled all the spaces completely, and topped off evenly to the level of the boards or planks. When as much of this part of the operation has been done nearing the end of the day or job, cement and sand should be thoroughly mixed, one part of the former to two of the latter, and mixed dry as before recommended for the ashes and cement, and also watered in the same way; this must be used to put the finishing touch to what will be the top of the wall, and with one man with a shovel to drop it at intervals along the top of the wall and another with a bricklayer's or plasterer's trowel—the latter being the most handy—a smooth face is put thereon that will be one of the most important and essential parts of the whole operation, for it is this which keeps the wall that is made of ashes and cement from crumbling; it certainly would crumble if the sand and cement were not applied, and at a time before the wall proper has had time to dry too much. A mechanical and smooth job may be made of the top of the wall if the operator will have a whitewash brush and a bucket of water convenient so as to apply it occasionally when the smoothing process is going on by the man with the trowel; a little water and the trowel following each other until a smooth surface is the result. If the "topping" part of the work just referred to is not done promptly, much time is lost in the completion of the job.

"After a few days—according to the weather and the time it takes to dry—the boards on the sides may be removed, and this, of course, must be done carefully; and these sides should receive a coat of cement in which sand has been mixed, in the same proportions as recommended for the top of the wall. Owing to the coarseness of the ashes used here, it is found when the boards are removed that although a more or less uniform or straight surface is presented, enough interstices will remain to give the sanded cement a good hold on the wall when plastered and, when thoroughly dry, the wall will be found as strong as though having been built of bricks, and at very much less cost.

"As to the cost of the materials, that depends upon what part of the country those who desire to build walls for solid beds in greenhouses are living in. In the natural gas region, ashes, which are so plentiful in other parts of the country, are at such a premium that they are quite out of the question in this connection, but in those sections probably, or at least possibly, sand or gravel or broken stone may be had for the hauling or at such a trifling cost that the same results may be obtained as low or at so little or no more cost that the difference is hardly worth considering; besides, it goes without saying that a wall made from sharp sand or gravel or broken stone, with cement in correct proportions is very much more substantial than can possibly be made with refuse ashes, though I must say that I have yet to find that a break has occurred in the walls built as per above method, excepting when some accident happened that no wall could possibly resist.

"I have one house fitted up with this class of wall whereon a a table is built so as to get an idea if possible on which plan roses bloom the best, but so far I am not able to decide. There are so many contingencies arising in the growing of cut flowers during a whole winter season that it is very difficult to decide which is the better plan. One thing we are sure about and that is, a solid bed is easier to empty and easier to fill than is a table, and no time is lost as in the repairing of the tables. Other matters which must be taken into consideration, whether solid beds or tables are the better, is the nature of the soil in which the plants are to be grown, and above all, thorough and proper drainage must be secured; if not naturally, then it must be made artificially."

In the building of tables or stages upon which to grow roses, carnations or other plants, the boards used for forming the bottom of said tables are usually six inches wide and are placed from a half-inch to three-quarters of an inch apart, and over the bottom of the table coarse manure, straw or material of like character is spread thereon to keep the soil from trickling through and also to aid in securing the necessary drainage. Drainage in pots is provided for by placing broken pots, oyster shells or coarse coal ashes at the bottom thereof. Any pot smaller than that known as a two and a half inch pot is rarely or never "crocked"—which the drainage in flower pots is called.

To go back to the drainage of the solid beds again. Some soils are so well drained naturally that there is no necessity of going to the trouble or expense of furnishing any other form of drainage. Generally speaking, however, it is believed to be safer to furnish some sort of drainage. Drain-tiles are sometimes laid in the length of the bed, and the deeper they are laid in the earth the larger the area which a given line of pipe will drain. Other florists lay two lines of tile the length of the house in each bed, only as deep as the natural grade would be, and these ends are left open and project through and flush with the outer edge of the retaining walls, as much to aerate the soil as to drain same from surplus water. Coarse coal ashes, broken bricks, stones or similar rough material is frequently used at the bottom of bed for the same purpose.

Sub-irrigation is being experimented with to some extent, but so far a cheap method of constructing a bed where sub-irrigation could be practiced to advantage has not yet been adopted to any extent. It promises well, I am inclined to think, but just the right plan of operation has not so far been hit upon.

ASPECT.

There is some difference of opinion as to the proper aspect of a greenhouse to be used exclusively for the production of cut flowers in winter, the consensus of opinion favoring a position a few points east of south. This aspect favors the early morning sun getting in his good work, which is considered the most life-giving, consequently of the greatest value and best not for plants alone but all animated nature.

When a greenhouse is built in which to grow Palms, Ferns and Smilax and other classes of plants which are grown for their foliage alone, it makes little or no difference which aspect the greenhouse occupies. Palms assume a deeper green and develop equally as satisfactorily if they are not given too much sun at any stage of their existence. In Belguim, where many Palms and other foliage plants are grown for the London, Paris, Berlin, Vienna and St. Petersburg markets, boards are largely used in conjunction with glass in the construction of roofs of greenhouses in that country. By the use of said material there is a great saving, not only in the construction of a greenhouse, but in the heating of same in the winter season. A greenhouse with a roof built of boards, or partly so, will retain the heat much longer than will one covered wholly with glass, and the desired temperature therein can be maintained at much less cost for fuel. We are assured by those who have seen the Palms growing under conditions as above stated, that no plants could be more luxuriant or healthy than they were. At the price glass was selling in September (1901), namely $7.28 per box of fifty square feet, a great saving could be effected by the manner referred to. Glass fluctuated very much last year; for instance, in September, $7.28 was the price per box of fifty square feet, whereas, in November, the same quality of glass could be bought for $4.55, and twenty years ago $2.00 per box was about the price.

It will be understood that what is herein said is merely suggestive, that much latitude is allowed in the selection of a site for a greenhouse establishment, according to what will be grown therein and the available ground to be used therefor; and also in the selection of the material to be used in the building thereof, many believing that as much iron or steel as possible should be used so as to have them as nearly indestructible as such structures can possible be made.

HEATING.

After the water supply has been determined upon and the question of drainage and aspect duly considered, another serious matter to occupy the attention of those desiring to go into the greenhouse business, is the different methods of heating, because, generally speaking, quite early in the operation a hole in the ground has to be dug, known by the old-school gardener as a "stoke-hole." Though some of the very largest and up-to-date commercial concerns, where steam is used as the heating medium, do not advocate digging a hole in the ground at all nowadays, but by placing the boiler or boilers at the lowest point naturally, according to the lay of the land, and by employing a small, though a separate and independent steam-boiler, which is so constructed as to work automatically and thus pump the condensed water back to the boiler; but in a small way that plan of operation would seem to be out of the question, the water returning by gravitation being the most practical now.

Generally speaking, it is better to dig a hole, especially in general use when only in a small way, whether the heating be done by steam, hot water, or the old-fashioned flue, for a better draft is thereby secured, which is a very necessary accessory in the keeping up a good fire to heat to the desired temperature the atmosphere of the greenhouses to the required mark; and, besides, a cellar is a great convenience in which to store, when possible, the winter's supply of coal.

There are several methods of heating, but three only will be necessary to consider at this time. What is known as the old flue system, which is practically a furnace with the chimney running nearly horizontally with a gentle rise to the further end and the whole length of the greenhouse and sometimes back again, and in this way the heat is given off enroute or in transit, as it were, and thereby warms the house. This was the first method of warming greenhouses, and when only one greenhouse is all there is to take care of this is certainly the cheapest plan of all; and where a variety of plants, coming from the different quarters of the globe, are to be grown therein this plan offers more variations of temperature to suit same in a given length of house than any other, that is to say, without special preparations are made with hot water or steam with that end in view. We, however, do not recommend the flue system for heating greenhouses, as it has some grave disadvantages, the principal one of which is the liability of deleterious gases escaping from the flue into the greenhouse being very great, and plant-life suffers in consequence, so much so that crops have been known to be total failures by the damage done to the leaves and flowers.

Hot water as a heating medium is perhaps the very best method of heating a greenhouse establishment in a small way that can be devised when the structures occupy not over 25,000 square feet to heat, because requiring less frequent attention than does steam. The main advantage of hot water over steam is, that there is not the same necessity of having a fireman up all night to attend to the fires when hot water is used, because so long as there is a handful of fire in the furnace there is sure to be some heat in the water; whereas, when steam is used, just so soon as the fire is not hot enough to make steam, then the pipes immediately become cold and on a freezing night damage is likely to result, either by the frost entering the greenhouses and killing the plants outright, or by so chilling them that many weeks might elapse before they fully recovered.

When, however, a greenhouse establishment has twenty-five thousand feet or over the glass under cultivation, it is better to use steam and employ a night fireman, and the right kind of a man who is willing to do other work during the night, especially in mild weather, there are lots of little jobs can be done to advantage, such as washing flower pots, putting in cuttings, and sometimes oven potting could be done. Great assistance can be rendered in the early morning by assisting to cut and pack the flowers for market, which in establishments of any pretensions, are shipped at least once and frequently oftener, every working day in the year and sometimes on Sundays. Flowers, being perishable, the quicker they are disposed of the better.

To return to the duties of the night firemen. They must watch the temperature closely. Many establishments are fitted up with electric thermostats to warn the proprietor or the manager or foreman when the temperature is too low or too high; this fact keeps many firemen on the alert when they would otherwise be indifferent and become careless. Self-registering maximum and minimum thermometers are sometimes used for the same purpose securely locked in a case so that they cannot be tampered with. There are several details to be attended to personally by the fireman besides shoveling on coal and keeping up steam. A pipe has to be "shut off" at this house, or a "crack of air" admitted through the medium of the ventilating apparatus, or an additional pipe "turned on" in another house in order to keep the atmosphere at the desired temperature. As before referred to, there is an automatic ventilating apparatus in use which is giving general satisfaction.

As to the fuel, whether it is best to use anthracite or bituminous coal, crude oil or natural gas must be determined by individuals for themselves. Natural gas, when same may be depended upon in unlimited supply, would be my own individual preference. No shoveling on coal, no cleaning of the fires, no ashes to take out. What a boon!

In and near to Philadelphia there is quite a lot of what is called "buckwheat" anthracite or hard coal used. This buckwheat coal, however, is only used where steam is the heating medium. Some others within the city limits use coke, a by-product in the manufacture of illuminating gas, while still others are using bituminous or soft coal; the latter has its decided disadvantages on account of the dense smoke produced therefrom and the resultant "blacks," entering the greenhouses through the ventilators which are very damaging upon all classes of flowers, especially the whites and other delicate tints, and by said blacks falling upon the glass more or less shade is produced, something to be avoided in the growing of flowers in the winter season when every ray of sunlight should be allowed to come through the glass as nearly as possible unobstructed.

When a battery of boilers is arranged conveniently in a central position or as nearly so as possible, and the greenhouses radiate therefrom, one man can attend to a much larger place and better than he otherwise could. With all essential conveniences for a night man, he can attend to 75,000 square feet of glass in ordinary weather, but when severely cold, an extra man would have to be brought in to assist. When it is impracticable to put in an automatic ventilating apparatus, and the place is large enough to warrant the expense of an additional man to look after the temperature of the houses, then the fireman may remain at the boilers all the time and having nothing else to do or think about except to keep up the necessary steam pressure to assure a complete circulation of heat to the remotest corner of the establishment, is a very satisfactory arrangement.

As a rule, with the requisite amount of executive ability centered in the guiding head, the larger the establishment the easier it is managed and naturally the more profits result.

We do, however, hear of an automatic stoker—a machine to coal the fire when needed. This I have not seen in operation, but there is no doubt about its being successfully done in a few large establishments. With such a machine and an automatic ventilating apparatus, two of the most important matters are provided for. All that would be necessary in such a place with those contrivances would be a night watchman, with men located conveniently to be on call in case of accident during the night, because in many large establishments there are thousands of dollars worth at the mercy of the elements in case of a breakdown in the heating apparatus or the breaking of glass.

To return for a moment to the subject of heating. The very best, because offering the least trouble and expense after the first cost, that I have heard of it in an establishment located at Helena, Montana, which is incorporated under the name of "State Nursery Company," the greenhouse department of which is heated by natural hot water. The hot water is conducted through the greenhouses in pipes, as is done when a boiler is used, excepting that no provisions are made for the water to return, flowing on after it has done its duty, apparently going to waste. The springs from which the water is taken are about half a mile away from the greenhouses, and the water is conducted in a wooden pipe under ground and has a fall of one hundred feet, which registers about thirty pounds pressure. The temperature of the water is 130 degrees when it reaches the greenhouses so that it takes more lineal feet of pipes to insure the atmosphere in the greenhouses being raised to the desired temperature than it does when the heating is done by the ordinary methods of steam or hot water as practiced in Pennsylvania. This item of information is introduced here incidentally to indicate the advantages that some florists have over others, especially out in far away Montana when the question of heating is under consideration.

DISEASES.

Mildew—so called probably on account of the mealy-like substance which is spread over the leaves of the plants affected—is the most common disease which affects roses and yet one of the easiest controlled. The very best way is to use preventives, which is done by using flower of sulphur mixed with about its equal in bulk with air-slacked lime, which is distributed with bellows made for the purpose into the atmosphere of the greenhouse to be operated upon. This effective mixture above described has been in use for some time, and its beneficial results were found out by accident. Florists and others who use sulphur in large quantities buy it by the barrel. During a rainy spell, which, by the way, is a good time to keep the mildew-killer active, the sulphur works sluggishly, on account, I presume, of its possible affinity for moisture; so in order to make it distribute more freely, some air-slacked lime, passed through a fine sieve, was added in about equal its bulk to the sulphur. This was found to be equally as effective as sulphur alone and more economical.

Many a careless hand wastes much of this material. The best way to apply it and the most effective and economical way, is to use the bellows referred to, fill same with the mixture and with the outlet pointing upwards and the operator working the bellows and walking backwards, the atmosphere of the structure will become well filled with this mildew antidote, and in settling ,which it will do gradually, it does so quite evenly and not unsightly as it is likely to do if the spout of the bellows is allowed to point downwards and the material irregularly distributed as is too often done. Another preventive for mildew, is to mix sulphur with linseed-oil to the consistency of a paste and apply with a brush to the heating pipes. The fumes of the sulphur are by this method believed to kill the fungous germs which are always more or less present in the atmosphere, awaiting favorable conditions to develop.

"Black spot" *inonema ro* , among diseases is the worst enemy the rose has to contend with, and this applies to those grown both indoors and outdoors, especially among that class of roses known as the "Hybrid Tea," which has for its parentage the Hybrid Remontant, or June rose, on the one side and the Tea-scented rose —a native of China—on the other. The Tea rose gets its title from a peculiar tea-like fragrance and not because it resembles tea in any other way. The LaFrance and Meteor, and possible the celebrated American Beauty, belong to the Hybrid Tea class.

The American Beauty appears to be the most susceptible of all roses grown under glass to black spot, and when a bad case develops it is very, very hard to get rid of. Bordeaux mixture, the same as recommended for fruit trees, is said to cure it, also copperdine; but I must confess that I have never yet found much if any benefit from the use of either. Potassium sulphide is also recommended. Any of the above might be used systematically as a prevention, and doubtless with more or less gratifying results.

It has been found, in practice, that no matter how badly affected a rose may be with "spot," at the end of the cut flower season, say the latter end of June or early in July, if all the branches are cut close from the plants about six inches to three inches from the base of the plant, these same plants, when they start to make a new growth, will grow without the slightest sign of black spot, and it is not until the month of September, when the growth made is from three or four feet high and densely clothed with leaves, that signs of this dread disease reappears; and then the cause is no doubt on account of some indifferent treatment given the rose, or some climatic conditions favoring the development of the fungus that science has not yet been able to detect in time to effectively stop, and it is found that the more luxuriant are the plants in the autumn months the more liable are they to this disease.

The plan followed and the safest, is to pick off and destroy by fire every affected leaf as soon as seen. If the plants can be safely carried through the late summer and early fall months without showing signs of black-spot, the danger from said disease is not so great, especially after the heating in the rose-houses has commenced, for little or no trouble will be experienced with it during the winter until firing is stopped in the spring, when it is again liable to appear at any time. And when it does make its appearance at the season of the year indicated, it spreads with great rapidity, being very difficult at that season of the year to combat. It is believed that the dew or any form of moisture upon the leaves and in the atmosphere favor the propagation and development of these disease germs, and as water must be directly applied vigorously to the underside of the leaf where that troublesome plant pest, the insect-mite known as red spider, takes refuge for self-protection, and as the water remedy recommended which is the only known method to dislodge him adds greatly to the moisture produced, it is readily realized how difficult it is to give water sufficient for all the needs of the plants and yet not enough to encourage the black spot scourge.

There are other diseases to which the rose is subject, but mildew and black spot are the most prevalent and those which give the most trouble and anxiety.

Carnations when grown under glass are liable to have quite a number of diseases. The one about which so much was said and which caused so much anxiety some ten years or so ago, was the so-called Rust (*Uromyces caryophyllinus*), but it does not possess the same terrors as it did at that time. In appearance it resembles smut in grain, the difference being that the black or dark brown dust-like material appears on the upper surface of the leaf and looks as though it were a bursted blister.

One which has caused, and is causing some anxiety to-day, is what was at one time known as *Bacteriosis*, now known under the scientific name of *Stigmonose*, and is the result of punctures by insects which are liable to infest Carnations. The insects responsible for this "puncture disease," are the most common of all plant-lice, namely, the green fly, or aphides, and to a lesser extent, thrips and red spider. The punctures made by these insects make it possible for the disease under consideration to develop. It goes without saying that to avoid the Stigmonose is to keep the plants free from insects. And the rust, strange as it may appear, is entirely gotten rid of by growing the plants under glass both winter and summer.

The present day carnations are a development from the hardy Dianthus Caroyphyllus of Europe, and some of the closely related varieties to-day will live out all winter in some parts of America when grown in a favored location. That the rust on carnation plants could be gotten rid of in America by growing same under glass, which is a hotter and dryer climate than is that of Europe, does seem difficult to realize, yet such has proven to be the case. It is the result of what is termed an "accidental discovery." The writer hereof, before the American Carnation Society at its convention held in Boston a few years ago, along the lines under consideration, said:

"Having a seedling carnation that was good enough to send out as a novelty the following spring, and in order to get up as large a stock as possible I kept on rooting the cuttings until quite late in the spring or early summer. It was so late, in fact, and the weather so dry that those plants remained in thumb pots all summer under glass instead of being planted outdoors. After the general collection of carnations had been lifted in the fall, this particular seedling showed unmistakable evidences of being affected with the much dreaded rust. As soon as possible all the affected leaves were picked off and distroyed; but when the job was completed the plants appeared to be planted too far apart, so much foilage had been removed, and in order to fill up the spaces we made use of the small plants which were rooted late and had remained in thumb pots under glass all summer. They were planted between the rows or lines of the affected plants, and, strange as it may appear, the unaffected little plants on each side of those were never affected by the rust during the whole season, and the older plants never recovered from the effects of the disease. At that time the rust had not created quite such a profound impression upon growers as it did later. This point is introduced here in order to show how it came that I decided to try buttercup under glass all summer. I reasoned in this way, that if one disease could be combated by this treatment, why could not other diseases be combated by the same treatment, and I am pleased to be able to say that the results have been eminently satisfactory. And to speak further, I believe that we will find that some of the choice varieties, if we wish to get the very best results from them, will have to be grown under glass all summer."

Since that time a modification of the cultivation of carnations has taken place. Instead of leaving the plants growing out of doors, as in the old way, to the end of September or sometimes even as late as immediately before damaging frost is expected, which varies according to location (in the vicinity of Philadelphia, however, it is about the middle of October, and some seasons it is a few days earlier and some a few days later than the time mentioned), now, in these days the first week in August is considered by a number of the most successful Carnation specialists to be the best time, and the date named for lifting is about the season when Carnations begin to make their most rapid and vigorous growth outdoors when the nights become cooler with more moisture in the atmosphere from the dews and fall rains. That the wisdom of the course now pursued is very readily understood when we consider the greater length of time the plants are growing outdoors, the larger and more succulent they naturally become and the more violent the shock from the breaking of the roots when they were lifted, that the only wonder now is that such a more rational method of treatment had not been practiced earlier. The plants not being so gross in growth at the earlier date, they are not injured nearly so much in the transplanting, consequently are not so susceptible to any of the diseases to which Carnations are liable; especially is this the case when the plants are in a weakened condition from the effects of the greater disturbance of the roots when transplanting under the older practices.

The various fungicides are no doubt excellent as preventives, and should be systematically used for that purpose, but when disease does show itself the affected parts should be immediately removed and destroyed by fire.

Stem Rot, which its name implies, is the plant rotting off just above the ground line. There is no positive remedy for this disease. To-day a plant affected with this disease may to all outward appearances be enjoying the best of health, and to-morrow it will be withered and dead. This malady among Carnations, according to Professor Albert F. Woods, Chief of the Division of Vegetable Physiology and Pathology of the United States Department of Agriculture, Washington, D. C., at the meeting of the American Carnation Society, held at Baltimore last year, stated that it is brought about through two distinct kinds of fungi. One which is known scientifically as *Rhizoctonia*, or wet rot, develops most in acid soils, especially where there is much decaying organic matter. The *Fusarium* is the scientific name of the other, or dry rot, and is not so prevalent as is the former among Carnations. Lime is found to be an excellent preventive when used on the soil for the former. One grower secured excellent results when he used between fifty and sixty bushels to the acre to combat Stem Rot. The second, or dry-rot fungus, grows best in a soil slightly alkaline. It is said to be closely related to the fungus which is almost driving out the cotton industry in both North and South Carolina. There are hundreds of acres of land where cotton cannot be grown any more where said fungus is present. This fungus has been found to retain its vitality for five years. No fungicides have been found strong enough to entirely rid the soil of its presence, as there is always enough left in the soil to start the disease on the next cotton crop. For greenhouse purposes the soil may be sterilized with steam at 130 to 140 pounds pressure when every germ of all fungi would be killed, and weed-seeds also, which would be a decided advantage. Some growers have thought that there is a possibility of the soil losing some of its fertility when sterilized, but the Professor stated that in some experiments with sterilizing soil for Violets no injury at all was apparent, instead the Violet plants grew entirely too rapidly. It is of course, for greenhouse purposes, that the sterilizing of soil is at all practicable. Some of our expert rose growers make a practice of systematically sterilizing all the soil used in their rose-growing operations, and they are prepared to prove that it pays to do so. Some soils, it is believed, contain more nematodes, or eel worms, than do others, and it is for the purpose of killing this troublesome little microscopic fellow in the soil that sterilizing is practiced for roses.

A disease called "Black Rust," but entirely distinct from that affecting Carnations, affects some greenhouse plants, Heliotrope and Verbenas, especially. The leaves affected show dark blotches thereon, and which, in a bad case, the leaves are more or less crippled. This is believed to be caused by one of the mite-insects, which require a strong microscope to detect. There is hardly any cure for this disease when in an advanced stage, and it is better to destroy the plants so affected entirely and start anew with clean, healthy stock. Stunted, half starved plants are the first, and generally the only ones, to take this disease, so that to avoid it, generous treatment is the one great thing needful to keep the plants healthy.

There are other diseases affecting plants, but those mentioned are the most troublesome, and in order to be sure that everything is being done that can be to avoid diseases in plants, cleanliness in every department in the greenhouse must be the watchword, and ought to be rigidly enforced; and it must be here emphasized that the various fungicides should only be depended upon as preventives, and not cures.

INSECTS.

The insect which bothers plant-life in greenhouses most, or in the greatest number, and at the same time the easiest to get rid of, is the "green fly," or plant-louse, one of the numerous species of aphis which has the power of reproduction to an extraordinary degree—too prolific almost to be fully realized.

The most common plan in practice towards destroying them is by fumigation, which means, in this case, to burn refuse tobacco stems, which are the midribs of the leaves of the fragrant wood (Nicotiana), which may be obtained in bales from a cigar factory, or from many seed stores which keep same in stock for the convenience of customers.

The process is as follows: A small bunch of dry paper or shavings, with a few dry stems to give the same a start, is placed at the bottom of a can made for the purpose, with a perforated base to cause the requisite draft, then the stems, with which the can is filled, and which are expected to do the effective plant-lice killing, before the light is applied, should be a trifle dampened; by this means flaming is avoided, which should never be allowed, as the hot flame with the deleterious gases generated under those conditions are likely to do serious injury to many tender plants which may be within the structure operated upon, as Heliotrope, Mignonette, and some other plants. When the tobacco stems are not too damp to burn, yet too damp to flame, it is just in the proper condition to produce the smoke, or the nicotine fumes, which suffocates our plant-enemy—the green fly.

Tobacco dust, when not too fine, may be used also for fumigating purposes, and is put into operation by placing the material upon plain paper in a perfectly dry spot on the floor of the greenhouse, and with a few drops of petroleum ("coal-oil") at one end of the pile of tobacco dust, then with a lighted match, touch the spot whereon are the drops of oil, when it may then be allowed to burn until entirely consumed, as no harm to the plants will result.

Paper steeped in a solution of saltpetre (potassium nitrate) and dried is also used upon which to place tobacco dust and burn. In this case no petroleum oil is needed; by touching the prepared paper with a light the combustion of both tobacco and paper is complete, and without flame.

There is also what is known as Aphis Punk on the market, a peculiarly prepared paper, which is hung on wire in convenient places in the greenhouse, and when lighted, is allowed to burn. This must not be allowed to flame either, or similar damage before referred to is likely to result.

There are also a variety of liquids much in use nowadays, where nicotine or the extract of tobacco forms the base and principal part of this class of insecticides. Sometimes these liquids when reduced to the proper degree of solution are applied directly to the plants troubled with insects, by spraying. Another plan frequently in use is when the liquid is placed in some convenient vessel and hot irons are dropped therein, and in this way is evaporated, filling the atmosphere full of the insect death dealing vapor. Some of the more advanced florists are using an evaporating pan which is attached to the heating pipes; the liquid is placed in the pans and in due course is evaporated into the atmosphere. When these have been used, no other means of green fly extermination is thought of, so thoroughly practical have they proven to be.

A spirit lamp is also used, attached to the bottom of a small vessel containing a highly concentrated insecticide, and when the lamp is burning the liquid is vaporizing, and in this and other methods of vaporizing, doing away with the clumsy methods of burning the tobacco stems altogether which is gradually becoming obsolete. The vaporizing of the different liquids is a step in the right direction, being equally as effective and far less troublesome and more agreeable for the operator than the old way.

To again refer to the pans attached to the one and a quarter inch steam pipes. It has been demonstrated that when in use in the palm houses, and the pans are filled with a tobacco extract regularly every night, neither mealy bugs nor scale insects will find a resting place therein or will be in any way troublesome. This applies principally when the young Palms are raised from seed at an establishment, which is equipped with the evaporating pans and none of the insects mentioned are brought there from a distance with other plants.

Roses and Carnations under glass are rarely or never bothered with either scale insects or mealy bugs, but Palms and Ferns are, and when once these pests obtain a foothold they are hard indeed to get rid of. Tobacco water sprayed on the Palms and Ferns twice each week systematically and intelligently applied, will rid the plants of said insects entirely. Many florists and gardeners, when they find their efforts are not rewarded sufficiently after the first few applications by a complete extermination, become impatient and disheartened and abandon the good work; when so easily discouraged all the work done up to that time will have gone for naught and the time and material as good as wasted.

Sometimes when a case of either of the two insects mentioned are found, or in fact any insect, it is often best to secure a soft piece of sponge and with soapy, warm or hot water—but it must not be hotter than 125 degrees or there is a liability of the leaves becoming damaged—the insects are "sponged" carefully off the leaves. Hot water up to the point above mentioned has been found to kill many insects, and that may be considered the cheapest insecticide obtainable.

Red spider (*Tetranychus telarius*) among insects, is the most persistent foe, and the hardest to conquer, when once well established, the plant-grower under glass, has to fight, so that the plant-lover must exercise the greatest care when introducing new varieties into his collection, so as to see that they are entirely free from all insect life before being brought into contact with his own collection, and by that method go a long way towards banishing injurious insects from our greenhouses.

Because it has been observed that the little mite of an insect, known to gardeners and florists and all those who grow plants and flowers under glass as the "red spider," appears to increase and multiply more rapidly in the most dry and hottest part of the greenhouse, then the conclusion is reached and the rash statement is made that moisture in the atmosphere will effectually banish him. Nothing could be farther from the truth. When the only method of heating greenhouses known was the flue system, which was in vogue hundreds of years ago probably, and which, owing to its primitive methods of distributing the heat, that end or part of the greenhouse where the furnace was located was the hottest and dryest, and that is where the spider flourished and was doing the most damage; and because at the end farthest from the fire there were less of the insects referred to than there were at the hotter end of the house, the writers of those days were led to make the assertion that a moisture-laden atmosphere was death to this insect, and many writers ever since have perpetuated the same old story. Many latter-day scientists know that much that passes for scientific knowledge too often is not the result of observation and investigation, but is merely compilation.

Professor Cranefield is a daring investigator, and the results of his recent investigations are herewith taken from the columns of the American Florist:

"Is it necessary to maintain a moist atmosphere in the greenhouse in order to keep down the red spider? Will not the spider thrive as well in a moist air as in a drier air? According to the evidence of experienced florists the spider is most destructive to Carnations when the temperature of the houses is maintained at 50 degrees or above at night and 70 degrees to 75 degrees in the daytime, whether the air be moist or dry. When the houses are maintained at 38 degrees to 45 degrees at night and 10 degrees higher in the daytime the spider is rarely troublesome, regardless of the moisture in the air. Roses are affected more or less according to the temperature maintained, the higher the temperature the more abundant the spider, regardless of the moisture in the air. Palm and Fern houses are usually free from spider, not on account of the moisture in the air, but because of the almost daily syringing the plants receive, thus destroying the spider by force, and secondarily, of course, the fact that these species of plants are less susceptible to attack by the spider.

"During the protracted heat and drougth of the past summer in southern Wisconsin many species of trees and flowering plants, notably Plums and Asters, were severely injured, in some cases killed outright by the red spider. This condition was no doubt largely, if not wholly, due to the lack of rain, the lack of the impact of rain drops on the leaves and consequent drowning of the insects rather than the lack of moisture in the air. Evidence in support of this theory was abundant in gardens where the plants were frequently and thoroughly syringed.

"Referring again to greenhouse work, in former articles on this subject which have appeared in the American Florist. I have noted the experiments in the plant houses at the Wisconsin Experiment Station, where live steam was allowed to escape into the houses for periods ranging from eight to twenty-four hours, completely filling the houses and without causing any injury or apparent inconvenience to the red spiders.

"In order to obtain more evidence on the subject an experiment was conducted last March in one of our plant houses as follows: A closed frame, sides, roof and ends glass, was placed on a side bench over steam pipes. In this frame was placed a variety of plants in pots, including Clothilde Soupert roses, Coleus, Heliotrope, Tomato and other plants. The plants had all been carefully syringed for several days and were all apparently free from spider when placed in the frame. The air was kept moist almost to the point of saturation for several days with no bad results to the plants.

"At the end of a week red spider was introduced by dropping on the plants several badly infested leaves from a rose plant growing in another house. Now, according to the commonly accepted opinion, the excessive moisture in the air in this frame should have prevented any increase of the spider. The actual results, however, were wholly different, the plants becoming quickly infested and at the end of three weeks were wholly destroyed by countless millions of red spiders. Both temperature and moisture were maintained at a high point throughout the experiment, the glass sides of the frame and the foliage of the plants being almost constantly moist.

"While these experiments do not furnish conclusive evidence that red spider will thrive in a moist atmosphere there is in it 'food for thought.' Is it not true that the spider is kept in check wholly by the force used in syringing? Does any gain result from the daily wetting down of walks, etc., practiced by greenhousemen?"

Sulphur in its different forms is believed to bother red spider more than any other one thing. A combination insecticide, known as Sulpho-Tobacco Soap, which, as its title implies, is made of sulphur, tobacco extract and soap, I have found about the best and most effective in stopping the ravages of this little pest; but to do any good it must be used nearly daily among plants when badly affected if we would have it produce the desired effect and restore our plants to health and vigor again.

A good force of water, say with at least thirty-five pounds pressure, applied directly beneath the leaves where red spider finds its resting and working place will be found to keep it from making much headway. The great disadvantage we are laboring under, especially in the dark, dull days of winter, is that we dare not use water on the foliage of roses too freely, or we run great risks of giving the plants more water than they need, especially on the leaves, and in that way encourage diseases that are even worse if possible than is the red spider.

SOIL.

Every tiller of the soil knows the importance of Mother Earth well tilled no matter what the crop. Any good, loamy soil properly prepared for a corn or any other farm crop, when the tiller is reasonably satisfied that it could not be improved upon, is all right to be used for nearly all plants grown in a greenhouse. If, however, the desire is to go to a little more trouble, then a few loads of sod from an old pasture lot should be secured and carefully piled up with some rich cow manure and ground bone and wood ashes, the two latter ingredients weight for weight in about equal proportions. The farm-yard manure will give all the elements of plant food, and the bone meal will give some ammonia and phosphoric acid, and the wood-ashes some potash additional and some lime. Place the sod grass side together and a layer of manure occasionally, about one load of manure to five loads of sod or good loam will be in about the right proportions, and an occasional sprinkling of the bone and wood-ashes, about one hundred pounds of each, would make an excellent compost. If this pile is put up in the fall, allow it to remain until the weather commences to get warm in the spring, then turn the pile over, taking care to break up the lumps should there be any, and mix well the whole together.

Soil for plants to be grown in a greenhouse should not be handled when it is wet, no more than it should for a farm crop. When preparing soil for large operations, the plan is to manure heavily a piece of old sod if possible with cow manure in the fall, and just as soon as the grass begins to grow, and before it grows too long so that it will plow down nicely and cover easily, it should be done without further delay, then a heavy roller should be passed over the soil as plowed a few times when possible to compress same; then use the drag harrow freely, in this way most of the little holes will be filled and an almost level surface will be presented. Then a good guaranteed quality of bone should be evenly distributed over the whole, and the ground harrowed thoroughly again a few times to mix the bone and upper surface of the soil well together. That done, then apply about the same weight of good, dry, unleached wood ashes in the same way. These should also be well mixed by harrowing. The plot is kept continually stirred by harrowing, especially when sufficiently dry after rain, and the harrowing answers another purpose, that of keeping down the weeds. This soil is frequently taken into the greenhouses in from three weeks to a month after plowing, but never before three weeks, because on one occasion serious damage was done when taken in sooner.

Crimson clover is being used to furnish humus and nitrogen in some establishments with satisfactory results. Cow peas also are being used to plow under for soil for greenhouse purposes. It is a safe rule to go by, that a soil on a farm that will grow first-class crops thereon is a safe soil to use in greenhouses. Sometimes it is deemed wise when the soil is of a heavy clay nature to add road or bank sand to make the soil more porous. Coal ashes, when the rough cinders have been screened out, are frequently used for the same purpose, and with no deleterious effects.

For Ferns, soil from the woods, known among gardeners as leaf-mold, is often used with excellent results. Muck from a low lying meadow, after it has been piled up on higher ground where the frost, sun and wind have a chance at it for several months to sweeten same, is often used mixed with equal parts of clayey loam to advantage, though muck is not recommended for roses. Air-slacked lime with good results is also mixed with this class of soil to correct possible acidity before it is used for greenhouse plants in which to grow.

PROPAGATING.

The most natural way to increase and multiply plants is by seeds, and numerous occupants of the greenhouse are increased in that way; but there are other ways of multiplying the number of a given variety, and that is by "cuttings" or "slips," and this perhaps is the most fascinating part of a fascinating occupation. To take a sprig of a plant and insert it in soil or sand and in three or four weeks' time we find tiny roots have been emitted from the base thereof indicates success and which means an awakening of the senses to both young and old, and the sensation incidental to the first attempt in propagating plants in this way is more readily imagined than described.

Grafting to increase in numbers some varieties of plants is frequently resorted to under glass, especially does this apply to roses. There is in some soils with some varieties of roses a decided advantage when grafted, and among the stocks used giving the most general satisfaction is one introduced into France and England from Italy half a century or so ago, and is known as the "Manetti" stock. The varieties of roses which show a marked improvement when grafted are what is known as the "Mermet" family, which consists of the Bride, a white sport from Mlle. Catherine Mermet before referred to, and Bridesmaid, another sport from the same variety which produces darker and brighter pink colored flowers than does the variety from which it sprung. Among the advantages claimed to be gained by grafting by many growers of roses for cut flowers in winter is, that the plants produce more flowers and flowers of better quality than they do on their own roots.

The varieties of roses referred to form roots very readily, as cuttings, when given the necessary care which consists of never allowing the sand in which the cuttings are inserted—which is generally known as a propagating bed—to become dry, nor to allow the cuttings to wilt by allowing them to be exposed unnecessarily long to the influence of the sun. Judicious shading of cuttings is at all times recommended, and a movable and not a permanent shading is considered the better, for if a cutting is rooted under a dense shade, the young plants, rooted under those conditions, are liable to have their constitutions impaired. Consequently material to be used as shading should only be placed over the cuttings when the sun's influence becomes too strong. Newspaper is very frequently used with which to break the fierce rays of the sun from the cuttings and is as effective as anything that can be used. If cuttings are once allowed to become dry and wilt, the chances of their ever forming roots is very remote indeed. On very warm days sprinkling the cuttings occasionally will be a great help towards keeping them fresh and in a possible growing condition. An atmospheric temperature of not lower than 56 degrees and not higher than 58 degrees at night and an under or bottom heat of ten degrees higher after the callous is formed, and the general temperature kept down in daytime as nearly to 65 degrees as possible, the cuttings should root in from twenty-one to twenty-five days and sometimes longer according to the condition of the wood used from which the cutting is made, while some varieties root in much less time than others.

Grafting is frequently resorted to because the subject which it is desirous to increase in numbers does not form roots readily, but that is not the case with the varieties of roses under consideration, namely, the white flowering Bride and the pink Bridesmaid, for no roses root with greater certainty than they. The great advantage the Manetti stock, before referred to, possesses for grafting purposes, is its strong tendency to produce numerous and vigorous roots, thus re-enforcing any variety, upon which a successful union —by grafting—with it has been made, against the many vicissitudes plant-life is heir to, whether said plants are growing outdoors or under glass, more especially perhaps when growing under the latter conditions.

A serious trouble with some growers of roses in some soils has been found in the presence of the so-called eel worm, scientifically belonging to the nematode family. These little worms in some way chew and feed upon the roots, causing what is known as "club root" thereon, thus interfering with the regular functions of the roots, and in consequence the general health of the plant is impaired. When grafted upon the stock mentioned if the eel worm is present in the soil, the vigorous constitution of the stock in question has the power naturally to recuperate quickly, and therein is where its utility and strength lies.

There is another stock recommended under certain conditions for grafting purposes for roses, and that is the Rosa Multiflora, a wild rose of Japan. This stock, however, has been found too vigorous for the section of the tea-scented rose in general use for winter flowering, furnishing sap presumably more freely than the Tea roses mentioned above can elaborate to advantage. The American Beauty has so far shown no decided advantages when grafted on the Manetti stock, which, by the way, is itself increased by cuttings, whereas the Multiflora is very easily raised from seed, which is much the cheaper way to get up stock, and if the Beauty took kindly to the latter stock it might be advantageous to use it for that purpose, because Beauty does not root with nearly the same certainty as does a Tea rose. It may or it may not surprise some growers to know that Golden Gate and its white sport Ivory, with their natural vigorous constitution, are considered by other experts to be improved by grafting on the Manetti stock.

Before leaving the subject of grafting, it may be mentioned that dormant pieces, with two or three eyes and two and a half inches long or so, of the celebrated and popular Crimson Rambler rose, which is seen on every hand outdoors in full bloom in the month of June in and near to the larger cities, and grafted on any congenial stock—the Multiflora has been found admirable for this purpose—and given proper treatment under glass, may be had in full bloom in a four-inch pot the latter part of March or early in April, and such plants make excellent gifts for friends, or would find ready sale if prepared with that object in view.

Carnations are easily raised from seed, but unfortunately out of one or two thousand young plants there may be no two alike and may be any other color than the variety which furnished the pollen or that which produced the seed, and two-thirds of the flowers are very likely to be single and of no practical value. But by seed is the way which such celebrities as "Mrs. Thomas W. Lawson," "The Roosevelt," "Prosperity," "Adonis," "Enchantress," and other meritorious varieties are brought forth; but to be absolutely sure that we will get the same color, form and size of any special variety, we must increase and multiply by cuttings. And what holds good in the case of roses in the propagating bed will serve as a guide to the management of Carnations, excepting that a cooler temperature is recommended for Carnations, from 52 to 55 degrees at night and not higher than 60 degrees in day time when possible and practical, with plenty of ventilation night and day, weather conditions permitting. Some varieties of Carnations are inclined to sport, so that a sharp lookout for a variation from the original is always in order.

Among the many favorite flowering plants for the greenhouse that may be raised annually from seed, are the Chinese Primrose (*Primula sinensis*), *Cineraria stellata* or the so-called hybrids from *C. cruenta*, and *Cyclamen*, all of which are deserving of a place in any and all cool greenhouses where pot plants are grown. All the above delight in an abundance of air on all favorable occasions, and a night temperature of 45 degrees will suit them admirably. This brings us to the subject of—

ANNUALS FOR WINTER BLOOMING.

Nearly all the annual flowering plants may be had in bloom in the winter-time, provided the seed is sown at the proper time. The Mignonette is an annual and is one of the most popular flowers for winter blooming that we have, principally on account of its unique and delicious fragrance. The size of the flower has been wonderfully increased during the past decade. This has been brought about entirely by selection. One of the pioneers in the improvement of the size of the flowers of the Mignonette states, that he secured seed from every source likely to have something superior to what was generally grown, and when all the plants resulting therefrom came into bloom, only one plant was set aside as approaching the ideal, and from this one plant, seed was saved, and this rigid rejection was kept up for years until a vastly improved strain has been secured. And what has been done for the Mignonette may be done for nearly if not quite all the flowering plants grown; especially does this apply to annuals. At present the Mignonette is the most popular annual grown for cut flowers, and the commercial value has been raised from a dollar per hundred twenty-five years ago, to fifty dollars per hundred, the latter price being realized at Chistmas time a few years ago. Though at the present time, I regret to say, so high price is not maintained even for the very select because the high grade has become more plentiful.

To find out just when to sow the seed of annuals to have them at a given time, at Christmas for instance, some experimenting will have to be resorted to and careful observations made and notes recorded appertaining thereto. Mignonette for winter blooming is generally sown the latter part of July and the beginning of August, and as it is a difficult plant to transplant successfully, the seed is recommended to be sown where the plants are expected to grow and bloom; if in a bed under glass, after the soil is carefully prepared the bed is checked off a foot or so apart each way, a few seeds are dropped at the junction, exactly the same as is the general practice when planting corn. Other growers sow a few seeds in a three-inch pot. In all cases only one plant is left, and the thinning out is done as soon as possible after the plants become large enough so that the most promising one may be selected, thus giving same every opportunity to develop into a strong and vigorous specimen. And the plan adopted in the growing of Mignonette may with more or less modifications be carried out with other annuals. The methods of culture will have to conform according to the use to which the plant when fully grown is to be put. For instance, the Mignonette is not grown to any great extent as a pot plant, it not being sufficiently showy for that purpose, as it is grown principally for cut flowers. It is generally grown in a solid bed especially prepared inside the greenhouse, though we occasionally see some excellent specimens grown in pots.

Among other annuals that are successfully grown for winter flowering are the different varieties of Sweet Peas, and so far as these are grown exclusively for cut flowers. The dwarf or Cupid varieties might be grown as pot plants, but the climbing varieties, to make presentable specimens, would have to be grown in large pots with the top of a birch tree or some other equally twigy bush to climb upon. All the varieties of Nasturtiums might be tried, both dwarf and climbing varieties. Some varieties would be found, after a test possibly, to answer the purpose for winter blooming better than others. In England such selections have already been made suitable to the existing conditions there. Whether the dwarf varieties would produce flowers of sufficiently long stems to be of any practical value in America for cut flowers can only be known by experimenting. Certain it is that as pot plants the dwarf varieties grown close to the glass in full sunlight, and in comparatively poor soil, and care taken not to give too much water, and in a temperature of from 56 to 60 degrees at night, very showy plants must result.

Other hardy annuals besides those named may be mentioned, *Salpiglossis*, among which are the various colors in browns, yellows, and crimsons, beautifully veined in lighter or darker shades with occasional dashes of blue, giving color combinations difficult indeed to describe. There are dwarf and taller growing varieties of these also, but among the taller varieties there are none which might be given the term climbing.

Brachycome iberidifolia or Swan River Daisy, is dwarf and compact growing, with flowers both blue and white with darker center, and is very much like a refined form of the Cineraria. If grown dwarf and compact, these would make very beautiful plants for dinner table decoration.

Schizanthus in a variety of shades and colors as purples, lavenders, pinks and whites can be had in bloom in the winter without any difficulty whatever, and they are certainly very light, airy and graceful. There is a new variety known as *S. Wisetonensis*, which is likely to be heard of in the near future, as it has met with much favor in London recently.

In conclusion, let me admonish all who operate greenhouses, whether for pleasure or profit, to attend strictly to every little detail, for if anything requires strict attention in every detail, both large and small, it is greenhouse management. No matter whether for pleasure or profit, cleanliness must be the watchword, for no matter if there are a few meritorious specimen plants in a greenhouse or greenhouses, a lack of cleanliness detracts very materially from a place so operated, no matter how pretentious.

When a mixed collection of plants is grown they should be cleaned from decayed and decaying leaves and flowers and rearranged at least once a week. The variety in effect produced by judicious rearranging is another of the charms of a greenhouse, and it is needless hardly to say that empty pots and dead and dying plants should be removed without delay. Plants respond very gratefully whenever intelligent attention is given to their needs.

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN NO. 98.

Bacteria of the Soil in Their Relation to Agriculture.

BY

FREDERICK D. CHESTER, M. S.

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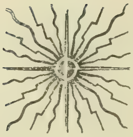

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PREFACE.

Harrisburg, Pa., August 1, 1902.

The following bulletin, No. 98, by Prof. Frederick D. Chester, Bacteriologist and Mycologist for the Delaware College Agricultural Experiment Station, upon "Bacteria of the Soil in Their Relation to Agriculture," is the discussion, by a specialist, of the phenomena that occur in the decomposition of animal, vegetable and mineral matter in the soil.

The bulletin deals with questions hitherto but little understood, and yet of vital importance to agriculture. The topic is essentially one of soil fertility, and how to secure it in the most economical manner.

Prof. Chester describes the changes that occur in soil ingredients, and indicates the causes or agents which produce these changes, and the methods to be employed to multiply them.

Through the careful study of microscopic organisms, the most skilled scientists to-day, are reaching the true cause of disease in human beings, and other animals, and discovering remedies that are effective in preventing or controlling these diseases. By the same means, agriculture is being benefited in the study of the characteristics of the low orders of organic life, that are such potent factors in providing fertility for the soil, and in retarding or assisting, in the growth of the farmers' crops.

The facts shown in this bulletin, make more clear than ever, the truth, that the future advancement of agriculture, must chiefly be, through the assistance of science, and farming people must, if they are to succeed, become acquainted with the discoveries and conclusions of science, as they apply to their profession.

This bulletin is not only worthy of attentive study, by the individual who wishes to know the reason why he should pursue one method in his agricultural practice rather than another, but also, by the scientific man who wishes to become acquainted with the latest discoveries in bacteriology.

JOHN HAMILTON,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

Delaware College Agricultural Experiment Station,
Newark, Del., June 30, 1902.

Hon. John Hamilton, *Secretary of Agriculture, Harrisburg, Pa.:*

Dear Sir: In accordance with your request I herewith submit a bulletin on Soil Bacteriology. The subject is one which is marked by the charm of youth, and like all new subjects is attracting more or less attention. The present bulletin is a brief summary of the present status of this branch of agricultural science, and may serve as a basis for more extended reading, provisions for which are met in the appended bibliography.

Yours very truly,
FREDERICK D. CHESTER,
Mycologist.

BACTERIA OF THE SOIL IN THEIR RELATION TO AGRICULTURE.

BY FREDERICK D. CHESTER, *Bacteriologist, Delaware Agricultural Experiment Station.*

The bacteria of the soil bear a most important relation to the nutrition of plants. If a soil be heated to a temperature sufficient to destroy its bacterial life, the growth of plants will be maintained therein only up to the point of the exhaustion of its easily soluble and assimilable plant food, at the end of which time they will die of starvation. The reason for this is that new plant food can no longer be elaborated since the agents concerned in the latter process are wanting. Should this condition of sterility of the soil continue it can no longer produce crops, and were this condition universal the world would become a barren waste.

In every soil a series of complete chemical changes are taking place, due to the activities of soil organisms. These changes involve the digestion of crude plant food whereby an otherwise useless constituent of the soil is put into such a state that it can be absorbed by the plant. Digestion, therefore, implies the rendering soluble of an otherwise insoluble substance.

Nutrition whether applied to animals or plants implies three distinct processes; digestion, absorption and assimilation. Digestion is the rendering soluble; absorption is the taking up of the soluble products, while assimilation is the elaboration of new tissues from the absorbed products.

Substances to be absorbed must be so changed that they will dissolve in the fluids of the organisms, which in the case of an animal, is the blood or lymph, and of the plant, its juices.

Starch taken as food is insoluble in the fluids of the body; it therefore cannot be absorbed until it is converted into a soluble sugar A morsel of lean meat is insoluble, however fine its state of division, hence before it can be absorbed it must be converted during digestion into a soluble pepton.

What is true of the crude elements of animal food is equally true of the crude plant food of the soil. Thus the granule of mineral matter, the bit of bone in a fertilizer, the shred of dried blood or other animal matter, the top and root of the clover turned under—

all these and many other forms of crude plant food are in themselves of no use to the plant until the elements therein are put into such a shape as to be taken up into the juices of the plant through the absorbing rootlets. Furthermore, as we have intimated, this work of digesting the crude plant food of the soil is continually being carried on by myriads of microscopic organisms present in every normal soil. Through their agency nourishment is gradually and continually being supplied to growing crops as rapidly as their needs demand, and there results a beautiful and wonderful relationship and balance between the life of the highest and lowest of the plant creation. The one is dependent upon the other, and independently neither can normally exist.

Such is the general relationship existing between soil micro-organisms and plant growth.

We are thus led to understand the importance of the study of Soil Bacteriology to general agriculture. The more detailed exposition of the subject, together with the relation of its principles to practice, will be outlined in the pages which follow.

I. THE ELEMENTS AND SOURCES OF PLANT FOOD.

Ninety-three to ninety-six per cent. of the dry weight of agricultural plants is organic matter, and is composed mainly of the four elements: carbon, hydrogen, oxygen and nitrogen. The remainder is inorganic or mineral matter which is recovered for the most part in the ash when the plant is burned.

The elements found in the organic portion occur in approximate proportions as follows: carbon 45 per cent., oxygen 49 per cent. hydrogen 6 per cent. Besides these, nitrogen may exist in amounts varying from 0.5 to 1.0 per cent. of the whole.

The green parts of all plants, but particularly the leaves, inhale and exhale atmospheric air. In the latter is ordinarily contained about four parts of carbon-dioxide for every 10,000 parts of air. Carbon-dioxide is composed of the elements carbon and oxygen in the proportion of one part of the former to two of the latter. It is this compound which furnishes to the plant all of the carbon and a portion of the oxygen.

The roots absorb water, and conduct it to the stem, whence it is carried to the leaves. Water contains the elements hydrogen and oxygen in the proportion of two parts of the former to one of the latter. Water furnishes all of the hydrogen and a portion of the oxygen. In other words, the two compounds, carbon dioxide and water, are brought together in the leaves and a chemical reaction between the two takes place, under the action of sunlight, by which these elements are combined in such a way as to produce starch.

Starch therefore accumulates in the leaf as a result of this process known as *assimilation.*

The various changes which the starch undergoes, and the manner in which it contributes to the nutrition of the plant, is a matter beyond the limits of our subject. But suffice it to say that 98 per cent. of the organic portion of the plant is manufactured by the process here indicated, so that it may be said that in the main the plant gets its food from the air and from pure water. But these elements alone will not suffice to maintain plant life; in fact no plant can grow without that vital substance within its cells known as protoplasm.

Plants grow by a multiplication of their cells, and cells empty of protoplasm are dead.

Protoplasm, besides containing the elements, carbon, hydrogen and oxygen, also contains about 16 per cent. of nitrogen. Most agricultural plants also contain in their dry water-free state from one-half to two per cent. of nitrogen in the form of proteids.

Plants obtain their nitrogen mainly from the soil, and so important is this element to their growth that a soil may be said to be rich or poor as its contents is high or low in nitrogen. In fact the problem of agriculture to-day is to supply to the soil an abundant store of this essential element.

The nitrogen of the soil is, in the main, stored away in its humus content, hence soils rich in humus are also rich in nitrogen. Thus it is nitrogen which the agriculturist seeks when he migrates to the prairie loams rich in humus, or when he reclaims the forest to possess a virgin soil. In fact it is the nitrogen problem with which the soil bacteriologist is more concerned than with any other, and its importance and bearings will be made more apparent as we proceed.

As has been intimated, from four to seven per cent. of the dry weight of the plant is composed of inorganic or mineral matter. In this portion we recognize, as most important, potash, soda, magnesia, lime, iron, phosphoric acid, sulphuric acid, chlorine and silica.

These occur usually in abundance in all soils, although not always in an available form; in fact many of them exist in an insoluble state and need first to be digested or rendered soluble before they can be absorbed by the plant.

Soil bacteriology is partly concerned with those processes in the soil by which stores of mineral food are unlocked to growing crops. But to understand these processes in full it will be necessary to consider for a moment the question of the origin of soils, and thus trace each step in the operation.

II. SOILS, THEIR NATURE AND ORIGIN.

Rocks form the solid crust of the earth. These when brought under the influence of the atmosphere, frost and percolating waters, etc., are broken and disintegrated, forming a layer of loose materials constituting the soil. The nature of these disintegrations and their resulting products vary with each mineral, and hence the character of the soil is largely dependent upon the mineral composition of the underlying rocks.

Let us take as an example a region underlaid by some rock of the granite family, such as is found under a considerable portion of southeastern Pennsylvania. Such rock will contain the following minerals: quartz, orthoclase feldspar, plagioclase feldspar, biotite, hornblende, and accessory apatite and magnetite. The composition of these several minerals will be represented in the following table:

Table I.

Name of Mineral.	Chemical Composition.							
Quartz,	Silica.							
Orthoclase,	do.	Alumina.	Potash.					
Plagioclase,	do.	do.		Lime.	Soda.			
Biotite,	do.	do.	do.			Magnesia.		
Hornblende,	do.	do.		do.		do.	Iron	
Apatite,				do.				Phosphoric acid.
Magnetite,							do.	

From the table it is seen that in the granite rock under consideration most of the mineral elements necessary to plant growth exist, hence a soil formed from its decay will contain the basis of fertility.

The process by which this rock becomes converted into soil is something as follows: The orthoclase, the plagioclase, the biotite and the hornblende in the above list are compounds of silica and alumina, various alkalies and earthy materials as potash, soda, magnesia, lime and iron. These latter compounds are slowly dissolved out of their respective minerals by surface waters, rain and atmospheric moisture, more or less charged with carbonic, nitrous, nitric and various organic acids until there is left behind only the silica and alumina, which combined with water form clay. The hard minerals just mentioned, bound together into a rocky mass are thus converted into a soft plastic material. The quartz on the other hand, remains undecomposed, but its grains are set free by the disintegration of the other minerals, and there results more or less sand, which, mixed with the clay, tends to loosen the latter and give it the character of an arable soil. It is not to be understood that all of the above minerals undergo dissolution uniformily. The feldspars begin to disintegrate first, the hornblende next, while the biotite mica remains for a long time unaffected. Thus there results a clay, the final product of the disintegration, mixed with quartz particles, or sand, together with fragments of undecomposed rock of greater or less size, giving the soil its open, porous or even stony character, so common in regions underlaid by the ancient crystalline rocks.

Besides the direct chemical actions already enumerated, other factors in soil formation of a physical nature might be mentioned. These are the expansion and contraction of rock masses; frost and freezing water; plant roots forcing their way into rocky crevices; beating and scouring rain; all tending to disintegrate the rocky covering of the earth and to open it more thoroughly to the subtle action of meteoric waters.

Another type of soils are those formed from the disintegration of limestones. Limestones are impure mixtures of carbonate of lime with various proportions of sand and clay. In the disintegration the great bulk of the carbonate of lime is leached out, and the insoluble sand and clay are left as the final product. Thus a limestone composed of 75 per cent. of carbonate of lime, may when converted into soil contain only a trace of the original carbonate. This residual soil is however more or less rich in the mineral elements of plant food while the as yet undecomposed particles in the residual sand, by continued disintegration, add new food materials to growing plants.

Sandstones undergo disintegration by the solution in meteoric waters of the materials which bind together individual grains. In this way the component sand particles are loosened, together with clay, which is generally an important constituent of most sandstones.

Whatever may be the character of the rock or of its contained minerals the process is the same, i. e., the dissolving out by means of percolating waters of the elements of plant food contained within the minerals. These percolating waters are furthermore made active solvents in the disintegration of rock through the acid products which they contain, which in turn are produced by the decay of organic matter through the agency of micro-organisms. Of the acid products the most active in this regard is carbon dioxide, which is the final product of the decomposition by bacteria of organic matter.

The chemical union between the carbon dioxide in percolating waters and the potash soda lime and magnesia in the minerals, results in the formation of carbonates and bi-carbonates of these bases, which being soluble, are in a large measure carried away in solution so that the residual soil contains but a certain proportion of these original stores of agricultural wealth. This loss of mineral plant food is illustrated in the following table, in which in the first column are given the percentages of lime magnesia potash and soda in an original gneiss rock, and in the second column the quantities of the same present in the residual soil.

Lime (Ca 0),	4.44	Trace
Magnesia (Mg 0),	1.06	0.40
Potash ($K_2 0$),	4.25	1.10
Soda (Na 0),	2.42	0.22

The question might here be asked why are not all of these elements of plant food entirely leached from the soil, and in what form are these residual materials held. In most soils a portion of them are locked up in the form of undecomposed mineral particles and fragments of rock, and it is the continued decomposition of these latter which furnish fresh stores of available plant food.

Another important chemical process going on in the soil is the formation of so called zeolitic compounds. As the alkalies, such as soda and potash, are dissolved out of the minerals by carbonated waters the carbonates thus formed possess a certain solvent action upon silica. This dissolved or gelatinous silica combines with the alkalies, resulting in the formation of zeolites. These secondary zeolites thus fix as it were the alkalies, notably potash, which might otherwise be leached from the soil. Furthermore, the especial affinity which potash has for zeolites fixes this, the most important of mineral nutriments, above all others. Thus if a zeolite be composed of silica and soda or of silica and lime, the potash in preference will enter into combination with the silica and the less valuable soda or lime will be set free.

Zeolites differ from the more insoluble silicates found in rock-forming minerals in the fact that they are readily decomposed by acid soil waters, thus setting free to plants their valuable nutrients.

III. THE SIGNIFICANCE OF SOIL BACTERIA.

Active and Potential Fertility of the Soil.

Since the different chemical changes taking place in soils, by which plant food is elaborated and rendered available, are in large measures the result of bacterial action, it is assumed that the larger their numbers, up to certain limits, the greater must be the rate of elaboration of plant food.

This is instanced by the fact that soils which are under active fertilization and cultivation, and which in the popular sense are considered fertile, are relatively high in bacteria as compared with those in the opposite condition.

In this we must distinguish between active and potential fertility.

A soil is actively fertile when plant food is being elaborated therein at a greater rate than required by the maximum demand of growing crops.

Such soils not merely contain an abundance of crude plant food, but the latter is being actively digested.

Such soils are, furthermore, always high in bacteria, showing that the latter are functionating vigorously under conditions most favorable to them.

A soil is potentially fertile when it is rich in plant food, but owing to unfavorable conditions or environment the soil bacteria are dormant, and thus either cease to digest plant food or do it so inactively as to fail to keep up with the demand of growing crops.

Thus forest and woodland soil are rich in humus and other crude plant food, but owing to their usually acid condition, as well as to their compacted state, the bacteria therein are able to develop but slowly, and but little available plant food is elaborated. Such soils are low in bacteria; but let this virgin forest soil be brought under active cultivation, especially if its acidity be corrected at the same time by means of a liberal dressing of lime, conditions favorable to bacterial life are at once created, the number of bacteria rises, and an actively fertile soil is the consequence.

Old pasture lands and permanent meadows possess potential rather than active fertility. In such soils the number of bacteria is relatively low, and plant food is but slowly digested. But such lands are at once converted into an actively fertile condition when brought under cultivation or when other means to stimulate bacterial life in the soil are utilized.

It is the function of the agriculturist to understand how potential can be converted into active fertility; in other words how land rich in crude plant food can be made large producer of crops.

An average of the results of 49 analyses of typical soils of the United States showed per acre for the first eight inches of surface soil 2,600 pounds of nitrogen, 4,800 pounds of phosphoric acid and 13,400 pounds of potash. The average yield of wheat in the United States is 14 bushels per acre. Such a crop will remove 29.7 pounds of nitrogen, 9.5 pounds of phosphoric acid and 13.7 pounds of potash. Now if all of the potential nitrogen, phosphoric acid and potash could be rendered available there is present in such an average soil, in the first 8 inches, enough nitrogen to last 90, enough phosphoric acid for 500 and enough potash for 1,000 years.

This is what is meant by potential fertility, and yet such a soil possessing this same high potential fertility, may, under certain conditions, be so actually barren of results to the farmer as to lead him to believe it absolutely devoid of plant food.

A soil at Rothamsted, England, which has been successively cropped to grain for 50 years without the addition of manure, and which consequently had become exhausted especially in available phosphoric acid, still contained a total of 2,880 pounds of phosphoric acid per acre in the first foot of surface.

Of this only 72 pounds per acre was soluble in a one per cent. citric acid solution. In other words, a soil which contained enough total phosphoric acid to support a wheat crop for 300 years, had, as a result of 50 years successive cropping, its store of available phosphoric acid so reduced as to leave a supply sufficient to last only between seven and eight years. This case is typical of thousands of others, and is illustrative of what is meant by soil exhaustion. It consists in using up original supplies of available plant food at a greater rate than they are being manufactured in the soil. Most of the older lands of the Atlantic seaboard which have been regarded as "worn-out" and exhausted are in much the same condition. Nevertheless they still contain large stores of unavailable plant food, which it only requires the application of modern agricultural practice to unlock. In other words, soils still potentially fertile must be made actively so, and since soils potentially fertile are low and those actively fertile high in bacteria, it would appear that one of the primary requisites of active fertility is to fulfil those conditions of the soil which favor the best development of bacterial life therein.

Numbers of bacteria in soils thus become an index of active fertility.

IV. METHODS OF DETERMINING THE NUMBER OF BACTERIA IN SOILS.

1. Drawing the soil sample. The determination of the number of bacteria in the soil of a given area involves an elaborate and careful preparation of the sample.

Studies at the Delaware Experiment Station have shown that the numbers vary considerably within rather narrow horizontal ranges, and thus to obtain an average sample, representative of an entire field, implies the collection and mixing of a large number of smaller samples. For most studies it will be sufficient to collect the first nine or twelve inches of soil, and for this a wood auger one inch in diameter is very satisfactory.

To preserve the boring intact a device such as is shown in Fig.

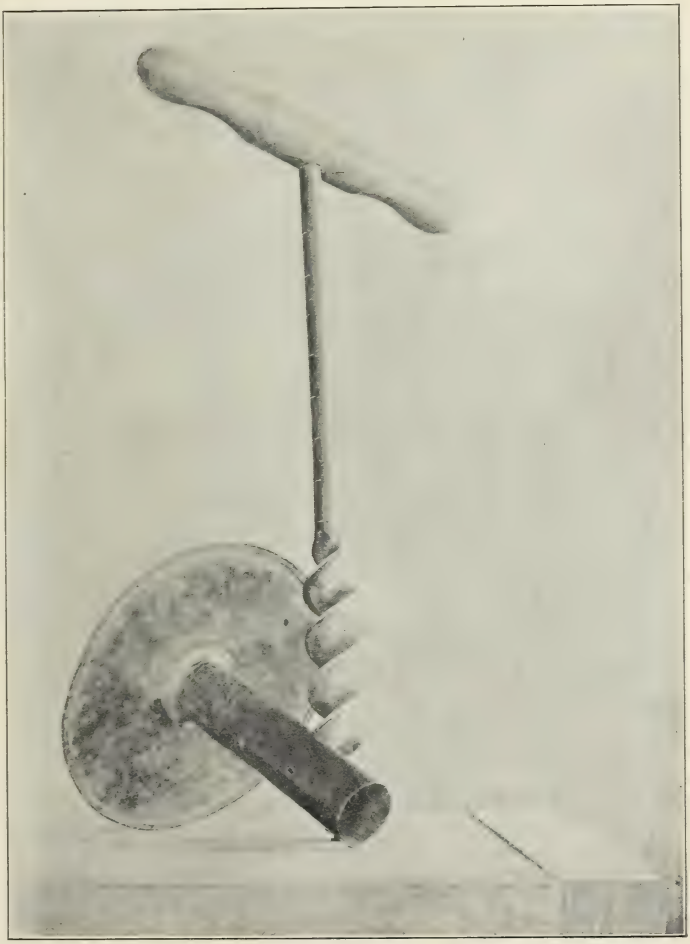

FIG. 1.—Apparatus for drawing soil samples.

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I, is used. It consists of a circular plate of copper, six inches in diameter, in the centre of which is a circular hole, one and a fourth inches in diameter, from which rises at right angles to the plate a copper tube of the same diameter and twelve inches long. The ground where the boring is to be made is cleared of all vegetation and the copper plate set firmly and held in place by both feet. The auger is then inserted into the copper tube, which should stand vertical to the ground surface, and the auger turned until the required depth is reached, as determined by graduations on the stem of the auger. The auger is then drawn gently from the ground and into the copper tube until the core of earth is enclosed in the latter, and thus kept intact. The earth is then emptied on a sheet of clean paper.

In getting an average sample for an entire field, borings should be taken along two intersecting lines diagonally across a field at intervals of ten or twenty feet according to the size of the plot. These separate borings are emptied into a clean box until the work is finished. The collected soil is then sifted through a No. 10 sieve, reducing the lumps but discarding stones and gravel. The sifted soil is then very thoroughly mixed, and from this a sample of about two pounds is taken to the laboratory.

The latter sample is sifted through a brass sieve of a one-millimeter mesh, and any lumps or coarse particles are reduced in a mortar until the entire sample has been made to pass the meshes of the sieve. The whole is then very thoroughly mixed and from this a small sample of about twenty grams is taken. This is then sifted through a 0.5 millimeter brass sieve which has been made sterile in a bath of boiling water, and dried over the bare flame of a bunsen burner. Any lumps or coarse particles which do not readily pass the sieve are rubbed in a sterile mortar until the last portion has passed. The siftings are then thoroughly mixed, transferred to a sterile test-tube and tightly corked.

2. *Making the analysis.* In a weighed glass-stoppered weighing-bottle approximately 0.5 a gram of the sample is placed, and the exact weight determined. The soil sample is transferred to a small sterile mortar and with a small quantity of sterile water rubbed to a fine mud, after which the last trace of soil in the weighing-bottle is transferred to the mortar by washing with sterile water.

The supernatant muddy water in the mortar is then transferred to a 100 c. c. flask containing sterile water; more water is added and the residue triturated; again transferred to the flask, and the operation continued until all of the soil in a finely divided state has been washed into the flask. The latter is then filled to the 100 c. c. mark with sterile water, and the contents vigorously shaken for exactly two minutes. One c. c. of this turbid water is then transferred to a second 100 c. c. flask, and filled to the mark with sterile water, shaken for one minute, and 1 c. c. of the dilution transferred to a tube of melted gelatin (5 c. c. in each tube), the latter gently rocked, and the contents poured into a Petri dish. The gelatin is made to solidify rapidly on a cold plate, and then placed in a cold water incubator for four days. At the end of this time the number of colonies on the plate are counted.

The result of the analyses are expressed in number of bacteria per gram of dry soil, hence it becomes necessary to know the percentage of moisture in the sample. For this a given weight of soil from the same tube is taken, and dried for three hours at 100° C., and from this the percentage of dry matter in the sample is calculated.

It is evident that in the mixing of the soil with water in the two 100 c. c. flasks there is in the 1 c. c. taken for the plate culture a one ten-thousandth dilution of the original quantity, hence the number of colonies on the gelatin plate must be multiplied by 10,000 to get the true number in the quantity of moist soil taken. To calculate the number per dry gram of soil the following formula is used:

$$N = \frac{N' D}{P W}$$

in which N equals the number of bacteria per gram of dry soil, N′ the number of colonies on the gelatin plate, P the percentage of dry matter in the sample, D the dilution of the soil sample (in most cases 10,000), and W the weight of the moist soil taken for bacteriological analysis

V. THE NUMBER AND DISTRIBUTION OF SOIL BACTERIA.

In the superficial portion of ordinary cultivated soil the number of bacteria varies from several hundred thousand to several millions per gram of dry soil. The following list will show the range of variation as observed by different authors:

1. Park Montsouri, Paris (Miquel. 1879),[2]	700,000
2. Sandy soil (Adametz, 1886),[3]	300,000
3. Clay soil,	500,000
4. Orchard, Potsdam (Fraenkel, 1887),[4]	31,000 to 218,000
5. Soil of grain fields (Caron, 1895),[5]	937,000 to 1,600,000
6. Pear orchard, Del. Expt. Sta., ground under high state of cultivation (Chester, 1901),[6]	2,200,000
7. Land in permanent grass for over 12 years, Newark, Del. (Chester, 1901),[6]	425,000
8. Land in grass for four years, Newark, Del. (Chester, 1901),[6]	425,000

9. Land, Newark, Del., under active cultivation during summer, now in crimson clover (Chester, 1901),[6]	1,880,000
10. Soil from the center of a strip of woodland, Newark, Del. (Chester, 1901),[6]	70,000
11. A family vegetable garden, Newark, Del. Rich in humus and actively cultivated,[6]	1,816,000

The preceding table, except No. 10, represents agricultural soils. In special instances the number may rise much higher, particularly in soils in the immediate vicinity of dwellings and stables. According to Manfredi,[2.1] the number of bacteria in the dust of the streets of Naples varied from 1,000,000 to 10,000,000 per gram, and even higher. Maggiora[2.2] gives figures as high as 78,000,000 for the number of bacteria per gram of soil in certain inhabited spots.

Adametz in 1886,[3] Fraenkel[4] in 1887, and Caron[5] in 1895, showed that the maximum number of bacteria were not found at the surface but at a depth of from nine to eighteen inches beneath the same.

In 1887 Fraenkel[4] showed that at a depth of from thirty to sixty inches there was a rapid and abrupt diminution of the number of germs from 200,000 at twenty inches, to 2,000 at thirty-nine inches, while at a depth of five feet no living germs were obtained. These results are not altogether in accord with results obtained by the writer in Delaware, which show that the maximum number of bacteria occurs in the first six inches of soil, below which they diminish at a very rapid rate, until at twenty-four inches only about one-five-hundredth of the number at the surface exist. Furthermore, it was found that the highest numbers exist not at the surface, but at a depth of about four inches below the same. In the following figure 2 is shown the rapid decline in the number of bacteria in the soil as the depth increases, determined at the Delaware station.

VI. CONDITIONS AFFECTING THE NUMBER OF BACTERIA IN THE SOIL.

The observations of Maggiora in 1887 have shown (1) that the number of germs in desert and forest soil is much smaller, other things being equal, than in cultivated lands; (2) that the number is proportionate to the activity of cultivation and the strength of fertilizers used, and (3) that light sandy soils contain fewer germs than those rich in clay and especially those rich in humus.

These results are in accord with those given in the preceding table, which show (1) the very low number present in woodland soil, (2) the very high number present in soils under active cultivation and (3) the relatively low number in soils covered with sod. The reason for these differences is apparent. Woodland soils, although rich in humus, are usually too acid for the best development of bacteria therein. Pasture lands, or lands for a long time in sod, are too compacted or imperfectly aerated. Most soil bacteria develop best in the liberal presence of atmospheric air, hence the opening up of such soils by tillage to the action of the atmosphere is essential before the best development of bacteria can take place. Pasture lands also have a tendency to become acid, a condition unfavorable to bacterial development.

In the studies at the Delaware Station, the highest numbers of bacteria were always found in soil which had been under active cultivation, especially when liberally supplied with humus, either by plowing under of green crops or by the use of stable manure. Thus in soil No. 6, of the preceding list, where the number of bacteria was 2,200,000 per gram, the latter had been enriched by repeated crops of crimson clover plowed under, accompanied by active tillage. Soil No. 11, a vegetable garden, had annual dressings of stable manure for a series of years, and had also been under constant tillage. The value of stable manure in increasing the number of bacteria in the soil has been shown by Miquel,[2] who found that after the application of this fertilizer the number of bacteria in the soil was increased from 700,000 to 900,000 per gram.

It may therefore be stated as a general principle that *the combined effect of high manuring and cultivation is to decidedly increase the number of bacteria in the soil, thus in turn setting free an increased quantity of available plant food.*

Soil Bacteria in Their Relation to Atmospheric Oxygen.

It has been stated that the great majority of soil bacteria develop best in the presence of atmospheric oxygen. Bacteria differ as regards their relation to this important element, and thus it has been the custom to divide them into three classes, (1) obligate aerobes, or those which do not grow except in the presence of oxygen; (2) anaerobes or those which grow only with the complete exclusion of oxygen, and (3) facultative anaerobes or those which are indifferent to the presence or absence of this gas. In recent times it has been recognized that no such sharp lines as these can be drawn; on the other hand these different classes merge into one another by indistinct stages of gradation.

A bacterium may, in a measure, show the ability to grow with the partial or complete exclusion of atmospheric oxygen, but it grows

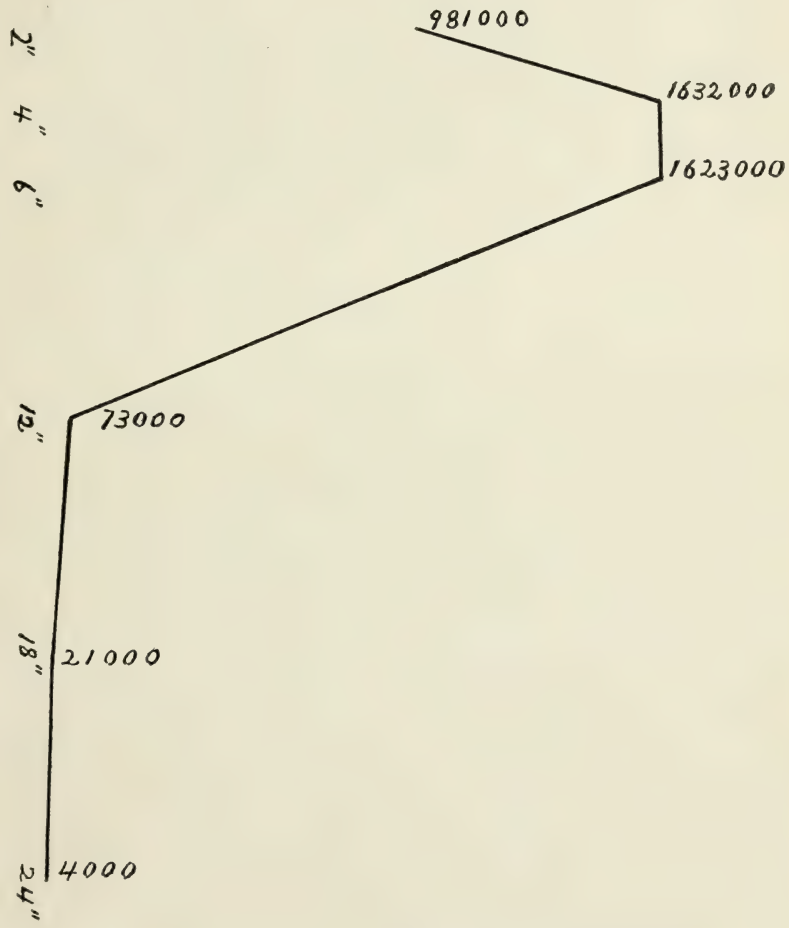

FIG. 2.—Showing number of Bacteria in different depths of soil. Experiment Station Grounds, Newark, Delaware, September 21, 1901.

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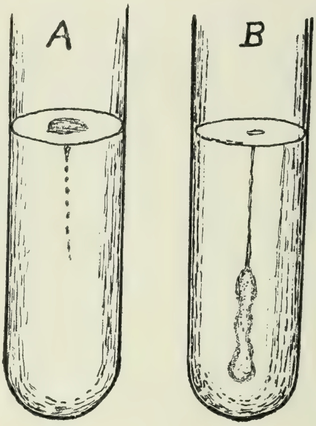

FIG. 3.—A showing ærobic growth, and B anærobic growth of bacteria in gelatin stab cultures.

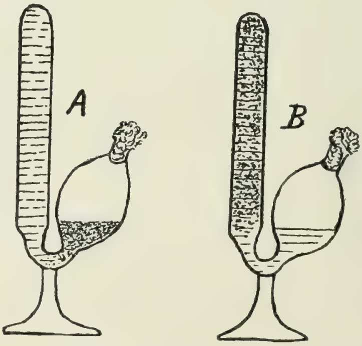

FIG. 4.—A showing ærobic, and B anærobic growth of bacteria in glucose bouillon in fermentation tubes.

less vigorously than when air is freely admitted; in this case the tendency is towards an anaerobic habit, but such a habit may not be fixed, and it may be changed in a measure by cultural conditions under the control of the bacteriologist. That is, an organism which has a slight anaerobic habit can be made to grow more and more freely with the exclusion of atmospheric oxygen. The relation of bacteria to atmospheric oxygen may manifest itself in a number of ways.

Thus if a fine sterile platinum needle be dipped into a bacterial culture, so that its surface becomes covered with a particular germ, and if this contaminated needle be then stabbed into a tube containing solid nutrient gelatin, a medium in which bacteria grow readily, the latter are, so far as food material is concerned, free to grow at all points along the line of stab, and their development is only limited by their ability to grow in the presence or absence of atmospheric oxygen. If growth takes place as well in the depth of the medium, where air is excluded, as it does at the surface where air is abundantly present, such an organism is clearly indifferent to its atmospheric environment. If on the other hand no growth takes place in the depth of the gelatin, but only on the surface, the organism would be aerobic in habit, as shown in Fig. 3 A, or again if the growth be confined to the deeper portion of the line of inoculation with no growth at the surface, the organism would show the opposite or anaerobic habit, Fig. 3 B. Between these extremes there will in different bacteria be seen to be a wide range of variation. In the different soil bacteria so far studied there was but little tendency for them to grow in the depth of the gelatin, practically all of the growth taking place at the surface, thus showing the generally aerobic habit of the great majority of them.

Another valuable method of demonstrating the relation of an organism to atmospheric oxygen is by means of a culture in a fermentation tube, seen in Fig. 4, containing beef broth to which two per cent. by weight of grape sugar has been added. In the fermentation tube it is noticed that one end of the same is open and exposed to the air while the other is closed and excluded from the air. If bacteria are disseminated throughout the broth in the tube, they will be free to develop in either arm as they find atmospheric oxygen favorable or unfavorable to their growth. Thus if the growth is confined to the open arm of the tube the organism concerned is aerobic, Fig. 4 A, and if confined exclusively to the closed arm, Fig. 4 B, anaerobic in habit, while if an equal amount of growth takes place in both arms it is indifferent to atmospheric oxygen and is consequently facultative anaerobic in habit.

Of ten of the most common soil bacteria recently studied by the writer, eight of them grew only in the open end of the fermentation tube, thus showing, in addition to the character of the growth in gelatin stab cultures, their distinctly aerobic habit.

In Fig. 4 A, is shown a culture in a fermentation tube to which was added 1 c. c. of a watery infusion of soil from the Delaware Station experimental grounds. In this 1 c. c. of infusion, something like 10,000 bacteria were introduced, out of the total of 1,000,000 present in the same, or one out of every hundred. It is therefore reasonable to assume that in this way at least the most important and predominating bacteria were introduced. As a result it is seen that all of the growth is confined to the open end of the tube. *Hence we may believe that at least the predominating bacteria of this soil were distinctly aerobic in habit.*

2. The Relation of Bacteria to Moisture.

One of the primary requisites of bacterial growth is the presence of moisture. If a soil becomes perfectly dry, not only do bacteria cease to multiply therein, but a large proportion of them die. It is the organic and in a slight measure, the inorganic materials in solution in the soil moisture which supply food for bacteria, hence the maintenance of soil moisture is one of the essential requisites for bacterial development. In short, those moisture conditions which are most favorable to the plant are likewise equally favorable to the bacteria of the soil. A free and uniform distribution of soil moisture is furthermore essential to a uniform distribution of bacteria, and hence to the active elaboration of plant food in all parts of the soil. It is clear that when the soil becomes dry to a considerable depth bacteria cease to develop and with it the digestion of plant food ceases; hence the maintenance of soil moisture by proper methods is important.

3. Relation of Soil Bacteria to Organic Matter and Humus in the Soil.

Inasmuch as organic matter and humus furnish food for soil bacteria it might be presumed that the greater the amount of such materials present the greater would be the number of bacteria and hence the greater the amount of plant food digested. Such is the case only within limits. If a solution be prepared containing one per cent. by weight of beef pepton, and be seeded with a soil organism capable of converting the pepton into ammonia and other decomposition products, a vigorous growth will take place, and a relatively large amount of decomposition products will be quickly formed; but soon active growth will cease, and that before the full amount of the original pepton has been completely decomposed. In short, the organism has been either killed or its energies have been paralyzed by the products of its own growth, which in this case have been produced in relatively large amount in the more concentrated solution. If on the other hand a solution be prepared containing only the one-hundredth of one per cent. of pepton, and be seeded with the same organism, growth in the latter medium will be relatively slow, with a correspondingly slow development of ammonia; but the decomposition will continue until all of the pepton has been decomposed. Furthermore, the activity of the decomposition will be as great at the end as at the beginning of the process, showing that the vitality of the organism has not been impared. This is doubtless because in the dilute solution the toxic products are not sufficiently concentrated to injure the life of the micro-organisms.

What is true here would be equally true of the state of concentration of the organic matter in the soil. If the latter be present in excessive quantity bacterial development will proceed for a time at an excessive rate, but soon products injurious to their best development will be produced. There is, therefore, a limit to the amount of humus which a soil should contain.

In forest and woodland soils the amount of humus in the surface layer is large. In such soils organic acids are generated in quantities too large for the best development of bacteria, and hence, as is found to be the case, the number of bacteria is low.

It has been shown that nitrification practically ceases in forest soils, due doubtless to the fact that the nitrifying bacteria, more than any other, are injured by high acidity and excessive humus.

The only condition which renders possible the addition of large stores of humus to the soil is subsequent tillage, which so stimulates bacterial growth as to lead to the destruction of organic acids, or to the production of ammonia, which neutralizes them. *Hence when a crop of clover or other legume is plowed under it is best followed by a cultivated or hoed crop.*

4. The Relation of Soil Acidity to the Number of Soil Bacteria.

It is important to know the conditions of the soil which are most favorable to the rapid development of soil bacteria. Among these nothing is so important as to maintain a proper reaction of the soil. Acid soils are infertile because soil bacteria, which are digesters of plant food, cannot grow therein. We say that lime when applied to land, among other benefits, assists in the decomposition of organic matter. This is true only indirectly. The lime neutralizes the acidity of the soil and renders it a more favorable medium for the development of those bacteria which are the true agents in the decomposition.

In determining the number of bacteria in soils it is necessary to use a medium the reaction of which is such that the maximum number will develop. Thus from a given dilution of a soil with water an average of seventy-two colonies developed in neutral gelatin, while with the presence of 0.25 per cent. of free alkali an average of thirty-four colonies developed, and with .07 per cent. of free hydrochloric acid an average of only one colony developed. Increasing quantities of citric acid added to the medium had the same retarding action, showing that with a distinctly acid condition of the medium but few soil bacteria would grow.

Of the different species of bacteria isolated by the writer from soils, none grew in a medium containing one-tenth of one per cent. of free hydrochloric acid, and either not at all or only feebly in one containing one-half of this acidity. All, however, grew in neutral media or in those feebly alkaline. A marked excess of caustic alkalies in the medium, approaching .02 to .03 per cent., had a retarding action on the growth of the bacteria, but where the less caustic bases like lime were added a considerable excess proved favorable.

The valuable results from lime added to neutral gelatin media is shown in the following table, in which is given the number of colonies developing in media containing different amounts of milk of lime, seeded with the same quantity of a one-ten-thousandths dilution of a soil infusion:

Table II.

Calcium Hydrate (Ca $(OH)_2$) Present in Medium.	Number of colonies which developed in the medium.
.44 grams per 100 c. c.,	57
.08 grams per 100 c. c.,	75
.12 grams per 100 c. c.,	82
.16 grams per 100 c. c.,	91

The valuable results from the use of lime seem to depend partly on the fact that it stimulates the development of soil bacteria. This was shown in certain pot experiments conducted by the writer.

Pots were filled with soil to which was added an equal quantity of clean gray stream sand.

To pots one and two nothing was added.

To pots three and four was added lime at the rate of 1,000 lbs. per acre.

To pots five and six was added lime at the rate of 2,000 lbs. per acre.

To pots seven and eight was added lime at the rate of 4,000 lbs. per acre.

The number of bacteria per dry gram of soil in each pot was determined at the beginning of the experiment, and again seven weeks later.

The results are shown in the following table:

Table III.

Pot. No.	Number of Bacteria Per Gram of Dry Soil.	
	At beginning of the experiment.	Seven weeks later.
1 Nothing,	441,000	440,000
2 Nothing,	567,000	395,000
3 1,000 lbs. lime,	734,000	1,026,000
4 1,000 lbs. lime,	703,000	2,076,000
5 2,000 lbs. lime,	908,000	1,325,000
6 2,000 lbs. lime,	406,000	1,319,000
7 4,000 lbs. lime,	457,000	4,481,000
8 4,000 lbs. lime,	504,000	6,662,000

The preceding experiment has been repeated with the same result, sufficient to demonstrate the value of lime, at least in the type of soils under consideration, in increasing the number of bacteria therein.

VII. THE CHEMICAL CHANGES PRODUCED BY BACTERIA IN THE SOIL.

The Elaboration of Plant Food.

The processes going on in the soil by which plant food in its crude state is prepared for the use of the growing crop are two, (1) the decay of organic matter and (2) the disintegration and disolution of mineral matter. They will be accordingly considered in turn.

1. The Decay of Organic Matter.

Organic matter, whether of animal or vegetable origin, when freshly incorporated with the soil, undergoes a partial and incomplete process of decay resulting in the production of a dark material known as humus.

The amount of humus in soils may vary from one per cent. in the soils of the arid region of the West to as high as five per cent. in black prairie loams.

The original supply of humus in virgin soils becomes a constant source of plant food through its slow but constant decay. Long continued cropping and tillage produces in time, however, a "burning-out," which means that the humus content of the soil is being gradually reduced. Thus according to Snyder,[8] a virgin soil with four per cent. of humus will, after twenty years of grain cropping, show a reduction to 2.5 per cent. of the same material.

2. Forms of Organic Matter in the Soil.

Organic matter becomes incorporated with the soil largely in the form of vegetable materials such as fallen leaves, sticks, seeds, straw, stubble, sod, the roots of various plants, green crops turned under, etc.

Such vegetable matter of whatever kind is composed of a framework of cells constituting its woody portion. The material constituting the walls of these cells is, for want of a better term, designated as cellulose, since the latter substance in one form or another predominates. Within the cavities of the cells, partially or completely filling them, may be found certain organic substances of which the most important are· (1) proteid matter, including protoplasm, proteid granules, aleurone and gluten; (2) carbohydrates, including starch, grape sugar, cane sugar, vegetable mucilage, gums; (3) fats and oils. Besides these are small quantities of a great variety of other substances, as glucosides, tannin, alkaloids, essential oils, resins, balsams, turpentine, coloring matter, etc. Notwithstanding the great variety of plant products, the principal materials, forming practically the entire bulk of plant structures, are included under the heads (1) cellulose, (2) proteid matter, (3) carbohydrates and (4) fats and oils. The decomposition of these several materials in the soil will be considered each in turn.

3. The Decomposition of Cellulose or Vegetable Fibre.

That straw and bits of woody fibre become soft and finally disappear as such when incorporated with the soil is a fact of common observation. Leaves and stems when mingled with earth rapidly lose their structural characteristics and become converted into a shapeless mass of mould. The log or stump under the action of biological and chemical agents decays more slowly, but eventually looses its structure and becomes converted into a brownish pulverent debris.

These changes involve the fermentation of cellulose or vegetable fibre, and are of special interest. The walls of vegetable cells are composed of matter more or less complex in character; but since cellulose in one form or another constitutes the basal portion of all cell walls, it has been common to refer to them as composed of this substance. But more accurately speaking cellulose is now understood to include a large class of plant constituents.

These latter may be grouped under two heads: (1) the celluloses and (2) the pectoses. The walls of different cells differ in the relative proportion of these two classes of bodies. Thus the walls of cells which constitute so called succulent or parenchyma tissue are relatively rich in pectoses. This is particularly marked in the flesh of fruits. Cellulose differs in its properties and ability to undergo fermentative changes. In the latter respect cotton fibres are the most resistant and the cellulose of seeds the least so, while that found in the fundamental tissue of the higher plants occupies an intermediate position. With the difference in the constitution of the cell walls of plants there results a marked divergence in their ability to undergo fermentative changes, and also a difference in the products of such fermentation. For this reason the fermentative decomposition of cellulose becomes an extremely complex phenomenon.

The dissolution of cellulose is brought about by the action of a ferment or *enzyme* known as *cytase.*

In 1886, DeBary,[9] found in the fungus *Peziza sclerotiorum* a substance which possesses the property of causing cell walls to swell, become gelatinous, and in a measure to dissolve. Two years later H .Marshall Ward,[10] found that a similar ferment was secreted by a species of Botrytis, commonly associated with the soft rot of a number of cultivated plants.

In his study of the latter, the author observed minute drops exuding from the filaments of the fungus, and in this exuding fluid was found a ferment in concentrated form, possessing the power when coming in contact with cell walls of softening and dissolving them. It was also observed that the ferment acted differently on different portions of the cell wall, and that its action was first upon the middle portion, or what is technically known as the *middle lamella.* This was followed by a swelling of the remainder of the wall, and by the appearance of distinct stratifications, which dissolve one by one in turn. In the swelling of the cell walls the latter assume a semi-mucilaginous consistency which has the effect of softening the entire tissue. Thus plants attacked by cytase secreting fungi, such as the ones named, undergo a species of soft rot.

In addition to the preceding observations Kean and Arthur[11] have recently shown that the fungus *Rhizopus nigricans* also secretes a cellulose dissolving enzyme. This latter fungus is a common cause of a soft rot of the sweet potato, a result in accord with the properties of the fungus. It is, furthermore, probable that a large variety of fungi associated with the soft rots of fleshy fruits and roots, possess the same property of secreting cellulose enzymes.

A number of the higher toad-stools and shelf-fungi, are associated with dry rot of timber, in which process the hard wood becomes converted into a brown pulverent mass. This disintegration is affected, it is now believed, through the ability of these several fungi to produce enzymes capable of softening and in a measure at least of dissolving cellulose or woody tissue.

Besides the fungi proper, certain bacteria have been shown to possess the ability to ferment cellulose. Thus as early as 1850, Mitscherlich[12] made the observation that cellulose could become soluble by fermentation. In the fermentation of the potato for instance he found the cell walls dissolved, and associated with this change he noted the presence of a species of Bacterium. In 1875, Popff[13] noted the relation between the degree of fermentation of cellulose and the development of certain gases, as carbon dioxide (CO_2) and marsh gas (CH_4). Later, in 1879, Van Tieghem showed by experiment that a solution of cellulose was effected through the action of a micro-organism related to *Bacillus amylobacter.* During the change, hydrogen gas was generated, also an acid, whose presence gradually hindered the fermentation process. Van Tieghem's observations that the fermentation of cellulose was due to the latter B. *amylobacter* was confirmed by Hoppe-Seyler[15] in 1886.

This fermentation as originally shown by Popff, and later by Hoppe-Seyler and Schlösing, was accompanied by the vigorous evolution of carbon dioxide and marsh gas, and took place in the absence of air.

The process consisted probably in an hydration of the cellulose, and its conversion into dextrose or a related body, and the subsequent fermentation of this secondary product as shown by the following formulae:

$$(1)\ C_6H_{10}O_5 + H_2O = C_6H_{12}O_6$$
$$(2)\ C_6H_{12}O_6 = 3\ CO_2 + 3\ CH_4$$

In 1890, Von Senus[16] showed that the fermentation of cellulose was not due to the action of B. *amylobacter* alone, but to its concurrent action with other organisms. In 1895, Omélianski[17] announced the discovery of a bacillus capable of fermenting pure cellulose, which he obtained from slime and soil rich in vegetable matter.

In the experiments of the author filter paper or cotton, representing cellulose in its purest form, was immersed in a solution containing sulphate of ammonia, pepton and asparagin, and into this culture medium the organism was introduced. The beginning of the fermentation was shown by the liberation of gas in from 6 to 10 days. An examination of the filter paper in from 3 weeks to a month showed an advanced stage of decomposition, and in from 3½ to 5 months 79 per cent. of the cellulose had been destroyed. The products of the fermentation were found to be carbon dioxide, hydrogen, volatile organic acids and minute quantities of the higher alcohols.

Whether bacilli identical with *B. amylobacter* of Van Tieghem, or the Bacillus of Omélianski, are found in all soils is a matter yet to be determined, but it is believed that organisms with similar functions are present in abundance. Furthermore, whether these bacteria decompose cellulose through their ability to secrete enzymes has also to be determined. DeBary in referring to *B. amylobacter* says it decomposes cellulose forming dextrin and glucose, and that it does so by disengaging an enzyme.

Although the experimental proof of this is lacking it is probable that the assumption is true.

Baccillus mesentericus-vulgatus, a common soil species, has been shown by Vignal[18] to secrete a cytase which dissolves the middle lamella of vegetable cells.

There is therefore every reason to believe that numerous organisms capable of fermenting cellulose exist in soil, and that they act upon cellulose, like the higher fungi, through their ability to produce cytase.

The action of cytase upon cellulose is to incite a chemical union of water with cellulose, a process known as hydrolysis, and is an action similar to that which takes place when cellulose is boiled in dilute acids. It consists in the conversion of the cellulose into some form of sugar, which differs with the forms of cellulose acted upon. These different forms of sugar are glucose, mannose, galactose, zylose and arabinose.

The pectoses, which have been found also to be important constituents of the cell wall, are under the action of cytase converted into reducing sugars. The different forms of sugar are then acted upon by other ferments and converted into organic acids.

This explains the common tendency of soils rich in vegetable matter to become acid, unless continued cultivation stimulates bacterial growth sufficient to decompose these less readily decomposable organic acids into their final gaseous products, carbon dioxide and marsh gas.

It has already been noted that all of the constituents of cell walls do not undergo dissolution equally. Hence when vegetable fibre undergoes fermentation in the soil there remains a residue which for a longer time withstands the action of these ferments. This latter constitutes the great bulk of that heterogeneous material which is called humus. Humus is, therefore, in the main, the product of the incomplete decomposition of vegetable fibre.

4. The Fermentation of Carbohydrates.

The carbohydrates in vegetable tissues exist mainly in the form of starch and sugar. In crops ordinarily used for green manuring they constitute between 40 and 50 per cent. of the dry weight of the plant. Starch is the most abundant carbohydrate of green crops, but sugar exists in small amounts, usually a fraction of a per cent. However, in fleshy roots, fruits, and in special cases, it may run much higher, reaching a maximum in the beet and sugar-cane of 15 per cent.

Sugar exists in different vegetable tissues in three forms: as cane sugar or saccharose, grape sugar or dextrose and fruit sugar or levulose. In animal tissues and fluids the carbohydrates exist: as glycogen, a modified starch, as dextrose, and in milk as milk sugar or lactose.

Bacteria play an important role in the fermentation of carbohydrate, and those concerned in these processes are abundantly present in all soils. The great majority of bacteria when growing in media containing grape sugar, milk sugar or cane sugar produce therein greater or less quantities of organic acids accompanied in some cases by the evolution of gas.

These acids are lactic, acetic, butyric, formic, propionic, valerianic and succinic. When milk sours, lactic acid is produced at the expense of the milk sugar by certain bacteria normally present in the fluid. Fruit juices and infusions undergo an apparently spontaneous fermentation, the sugar being converted into alcohol through the agency of the yeast plant, with the subsequent conversion of the alcohol into acetic acid.

Many bacteria are, however, capable of directly converting sugar into one or more of the organic acids, without the intervention of alcohol; in fact, it may be said that the ability to convert sugar into one or more of the organic acids is almost a universal property of bacteria, although they vary among themselves as regards kinds and quantities of acids produced.

In order to better understand the fermentation of the different carbohydrate constituents of plants, it will be best to consider them in turn.

(*a*) *The Conversion of Starch into Sugar.* When seeds germinate, a marked change takes place, the most notable of which is an alteration and an eventual solution of the starch granules which fill the cells. In proportion as the starch disappears there is a corresponding increase in sugar. In the preparation of malt from barley the same change takes place. The barley grains are allowed to sprout under favorable conditions of heat and moisture, during which a considerable proportion of the insoluble starch is converted into a soluble sugar. If a quantity of this malt be steeped in water, especially if the malt be macerated to a pulp, the greater portion of the sugar, a part of the soluble starch and dextrine bodies and other extractive matter pass into solution. If a portion of this extract of malt be allowed to act upon starch it will be found to possess the power of converting the starch into sugar. Furthermore, if several volumes of strong alcohol be added to a volume of the malt extract a whitish precipitate will be thrown down, which can be collected on a filter and redissolved in a small quantity of water. If now this watery solution be allowed to again act upon starch, it will be found to possess properties identical with that of the simple infusion.

Malt extract, therefore, contains a substance which is precipitated by alcohol and which has the power of converting starch into sugar. This substance is called *diastase* or *amylase.*

Diastase has an important function in relation to the nutrition of plants. Plant food exists largely in the form of starch, but which in this shape is of no use, since it is insoluble and therefore incapable of being carried in solution to growing parts; in short, the starchy food of the seed must be digested before it is available, and this digestion is effected through the agency of diastase. Similarly, starch is formed in the leaves and other green organs of the plant, but before it can be utilized as food it must be converted into sugar. To effect this change diastase is present in all leaves and organs where starch is being elaborated. Many trees store up during the winter reserve material in the form of starch which becomes food for unfolding buds on the advent of spring. Thus Desbarres[19] found in the young wood of *Rhus elegans* 17.31 per cent. of starch during the winter and only 1.57 in the spring.

The sugar maple yields in the early spring a sweetish sap which is produced from the reserve starch accumulated in the wood during the preceding fall.

Many roots and tubers are notable for their large content of starch, which, in all biennial plants, serves as food for a second season's growth. When potatoes sprout they draw largely upon the starch of the tuber, and with the elongation of the sprouts we note a dimunition of the starch and an increase of sugar. With this there is an accumulation of diastase in the tuber at the points where the sprouts originate.

In refering to the fermentation of cellulose, it was stated that it is a common function of many enzymes, of which diastase is one, to effect the hydration of certain organic substances, or their union with water.

The hydration, or conversion of starch into sugar, is a complex process, not as yet altogether understood, but the two products of the change are evidently maltose and dextrin. It can perhaps be expressed according to Musculus[20] by the following:

$$\frac{2\,C_{12}H_{20}O_{10}}{\text{starch}} + \frac{H_2O}{\text{water}} = \frac{C_{12}H_{22}O_{11}}{\text{maltose}} + \frac{C_{12}H_{20}O_{10}}{\text{dextrin}}$$

Dextrin, which is a residual product of the partial hydration of starch does not, however, remain as such, but is eventually converted into maltose.

When vegetable materials are incorporated with the soil, it is not likely that bacteria play a very important role in the conversion of this contained starch into sugar. On the other hand the change is likely brought about by diastases normally present in the plants themselves, and the greater part of this transformation is effected before bacteria have time to reach the starchy materials within the cells. Thus in the decomposition of vegetable matter in the soil, much at least of the fermentation of starch is a process quite independent of the action of bacterial life. This does not indicate, however, that certain bacteria and fungi are not capable of effecting this change, in fact Fermi[21] has shown that a considerable number of bacteria secrete diastatic enzymes, notably, *Bacillus megatherium*, *Bacillus, mesentericus-vulgatus* and *Bacillus subtilis*, forms commonly present in the soil; and it is likely that a residual portion of unchanged starch may be acted upon by such organisms, though this statement will require experimental proof. It is also known that certain common moulds, for example, *Pennicilium glaucum*, *Aspergillus niger and Erotium oryzae*, possess the power of converting starch into sugar.

As already mentioned, the action of diastase upon starch consists in its conversion into maltose and dextrin, but maltose has only a temporary existence in the animal and plant organism, since it is acted upon by another enzyme known as *glucase*, which further hydrolyses the maltose converting it into glucose. Thus glucose is the final product of the fermentation of starch.

Glucase is present in the digestive fluids of the human body. It has been found in corn and malt, and in several species of fungi. That it probably exists in association with diastase in plant tissues is made probable by the fact that maltose as such is unable to nourish growing cells.

(*b*) *The Inversion of Cane Sugar.*—When a solution of cane sugar is boiled with a dilute acid it undergoes an hydrolysis by which it is converted into glucose and levulose according to the equation:

$$\frac{C_{12}\ H_{22}\ O_{11}}{\text{cane sugar}} + \frac{H_2\ O}{\text{water}} = \frac{C_6\ H_{12}\ O^6}{\text{glucose}} + \frac{C_6\ H_{12}\ O_6}{\text{levulose}}$$

That the same change can be effected through the agency of an enzyme has been known ever since the latter was first isolated from yeast in 1860 by Berthelot.[22] This enzyme is known is *invertin.* It has also been found in the intestinal juices of man and a number of animals, and from various parts of plants as leaves, seeds, roots and floral organs.

Cane sugar is found often in considerable amounts in plant tissues, and yet as such it is of no direct use as a plant nutrient, but must first be digested or converted into glucose. Thus the beet may contain 15 per cent. of cane sugar. When, however, the latter is drawn upon for the production of flowers and seeds during the second year's growth it has been noted that its content of cane sugar gradually diminishes and glucose takes its place, the latter being traced in its ascent from the root to the developing leaves and flowers. Thus the presence of cane sugar in the plant implies the existence at the same time of invertin. The first step therefore in the fermentation of cane sugar is its conversion into glucose through the agency of its associated *invertin.*

This change like the action of diastase is also one which takes place in the soil independent, in a large measure at least, of bacterial action.

According to Fermi[21] and Montesano the production of invertin enzymes by bacteria is uncommon, although certain prevalent soil species, such as *Bacillus megatherium*, *Bacillus fluorescens-liquefaciens and Bacillus vulgaris*, are known to produce them.

The action of invertin is favored by the presence of small amounts of acid; it is therefore likely that in the acid fermentation of plant tissues and the normal presence of invertin ferments there is every condition favorable for the conversion of all the cane sugar into glucose independent of the action of bacteria or other micro-organisms.

(*c*) *The Fermentation of Glucose.*—From the foregoing statement it has been seen that all of the carbohydrates mentioned are eventually converted into glucose mainly through the action of enzymes. It is in this form that they are supplied to the various soil organisms. Through their agency glucose is converted into the various organic acids, into one or more of the alcohols, with or without the evolution of gas in the form of carbon dioxide and hydrogen.

The great majority of bacteria possess greater or less power of producing one or more of the organic acids from glucose, although much work has yet to be done in determining the kinds of acids produced by different species. The following table shows the products of the fermentation of glucose by a number of common bacteria:

Bacillus acidi-lactici—acetic and lactic acids, traces of alcohol and gas.

Bacillus aerogenes—acetic, lactic and succinic acids, alcohol, carbon dioxide and hydrogen.

Bacillus typhosus—lactic acid.

Bacillus coli—acetic, formic and lactic acids.

Bacillus prodigiosus—formic and succinic acids.

Bacillus butyricus Botkin—acetic, butyric, formic, propionic, lactic, and succinic acids; butyl and ethyl alcohol, carbon dioxide and hydrogen.

Bacillus amylozyma Perdrix—acetic and butyric acids, carbon dioxide and hydrogen.

Cholera Micospira—lactic acid.

Micrococcus pyogenes—lactic and valerianic acids.

Streptococcus pyogenes—lactic and volatile organic acids.

The organic acids produced by the fermentation of glucose tend to combine with any free base in the soil such as lime, soda, potash, and, in a measure, to decompose carbonates. But where this base is not present in sufficient quantity the free acids accumulate and the soil becomes sour. Under active cultivation, however, the acids and their salts undergo a still further fermentation whereby they are converted into carbon dioxide and marsh gas (CH_4).

Thus cultivation has a tendency to overcome acidity by stimulating the growth of those bacteria which destroy organic acids.

(*d*) *The Action of Oxidizing Enzymes in the Fermentation of Vegetable Matter.*

It is a common phenomenon that where grass or green hay is made into a pile the interior will begin to ferment, and with this there will be a considerable rise of temperature. A similar process goes on in the manure heap, and another when green fodder is packed in the silo.

In the silo the temperature in the center of the fermenting mass may rise as high as 150 degrees F. With this fermentation there is a considerable loss of organic matter which may vary from 4 to 40 per cent. The temperature as well as the loss of material in the silo is dependent upon the amount of air, or more properly the oxygen present, and this depends upon the looseness or density of the packing. The change is manifestly one of combustion due to the absorption of oxygen, and the products of this change are the same as those evolved in any other combustive process, i. e., carbon dioxide and water. Furthermore, the amount of carbon dioxide evolved is a measure of the degree of combustion and of the organic matter consumed, as well as of the heat produced.

Formerly it was supposed that the fermentation of silage was due to the agency of bacteria, but now it is believed to be simply an expression of the vital energies of the plant cells. All vital energy manifests itself in the production of heat; this heat is the result of oxidation, or the actual burning or destruction of a portion of the vital substance. Yeast when massed into a heap shows a rise of temperature due to its vital energies. This rise takes place only in the presence of oxygen or air, and in a vacuum no such increase of temperature occurs. The germination of seed is accompanied by a rise of temperature, and oxygen is necessary to the process.

The animal body gives off heat and the air we breathe is the draught for this ever consuming fire within, while the carbon dioxide exhaled is a measure of the rapidity of this combustion process.

In a similar manner plants evolve heat and their substance is, in a measure, oxidized or burned to supply this heat, a portion of which is converted into the vital energies of the plant.

Respiration is the breathing-in of air and the breathing-out of the gaseous products of combustion. This takes place in both animals and plants, and heat is the result. Hence when green vegetable matter composed of living cells is massed together these processes of respiration will continue for a time, and heat is the result. When such matter is massed together the heat evolved can not readily escape, and a considerable elevation of temperature is the result.

But the question may be asked, what causes the oxygen of the air to combine with the elements of organic matter whereby this combustion is affected. Under ordinary conditions oxygen has no affinity for organic carbon. Something must be present to stimulate this combination.

We have already found how water is made to combine with certain organic compounds through the agency of special enzymes, so in accordance with this it has recently been shown that a number of oxydation processes can be effected through the agency of another class of enzymes known as *oxydases.*

It has been already noted that yeast when in mass developes a rise of temperature, and it has generally been assumed that this is due to the respiratory activities of the cells, but it has recently been shown that there can be extracted from the yeast cells, independent of the cells themselves, a substance which has the power of oxidizing glycogen with a perceptible increase of temperature.

Thus it appears not to be the vital protoplasm of the cell but some substance which can be extracted therefrom which possesses the power of oxidizing organic matter with the production of heat. This active substance is an oxidizing enzyme.

It is now quite generally believed that oxidizing enzymes are quite generally distributed throughout vegetable tissues, and that they occur dissolved within the fluids of the cells.

In the presence of oxygen they cause a union of the latter with carbon, carbon dioxide being evolved. Thus it may be considered at least a working hypothesis that all processes of respiration are associated with the activities of oxidizing enzymes.

When green fodder is cut and placed in the silo, cells previously protected from the air are exposed, and the combined action of the air and the liberated oxidizing enzymes results in a rapid oxidation with loss of substance.

When fruits are cut open their exposed surfaces turn dark, due to the combined action of contained oxidizing enzymes and the atmosphere.

Besides the ordinary gaseous products of oxidation, it has been shown that oxidizing enzymes may produce certain by-products, notably the organic acids. Thus ensilage may become sour without a trace of bacterial fermentation.

Fresh olives when placed in heaps ferment. With this there is an increase of temperature, a liberation of carbon dioxide, and the formation of acetic and other fatty acids. Talomei shows this fermentation to be due to a special oxidizing enzyme which he called *olease.*

When green crops are plowed under their tissues continue to undergo an oxidation or respiratory process similar to that which takes place in silage. The carbohydrates are mainly attacked with a certain loss of substance, the evolution of carbon dioxide and probably the production of organic acids. This process, however, does not continue long but is succeeded by the ordinary bacterial fermentation already stated.

5. The Decomposition of Proteid Matter.

Proteid matter is a valuable source of plant food because of its contained nitrogen. This nitrogen before it can be easily assimilated by the plant must be converted into the condition of nitrate. The stages leading up to the production of nitrates are:

1st. Putrefaction or the conversion of proteid matter into ammonia (ammonification).

2d. The oxydation of ammonia to nitrites, the first stage of nitrification, and,

3d. The oxidation of nitrites to nitrates, the final stage of nitrification.

These processes will be considered in turn.

(*a*) *Putrifaction and Ammonification.*

Liebig[23] and the older investigators considered putrefaction a chemical process, the final products of which were carbon dioxide, water and ammonia.

In 1837 v. Schwann made the important discovery that fermentation and putrefaction germs were invariably found in the atmosphere, and it was left to Pasteur and his co-laborers to demonstrate finally that putrefaction was due to the agency of micro-organisms.

Since the early discoveries of Pasteur it has been shown that a great variety af bacteria found in soil, water and organically polluted fluids are capable of effecting the decomposition of albuminous or proteid matter.

The first step in the change is the conversion of insoluble proteids into soluble peptones, a process similar to that which takes place in the stomach. The liquefaction, or as it is called, the peptonization of proteids is effected through the ability of the bacteria to secrete an enzyme of the nature of animal *trypsin*. All bacteria which liquefy gelatin have peptonizing properties to a greater or less degree, and hence the power of converting proteids into peptones. Liquefying bacteria are abundantly present in all soils, hence the vital agencies are there at work which cause a rapid peptonization of all proteid bodies.

The next step in the process is the conversion of peptones into amido-acids and basic amines.

The following is a list, after Rideal,[24] of the amido acids which have been found as products of the putrefaction of proteids:

Name.	Constitution.	Formula.	Products of Further Decomposition.
Glycocin, ...	Amido-acetic, ...	$CH_2(NH_2)COOH$,	Ammonia and acetic acid.
Leucin, ...	Amido-isocaproic, ..	$C_5H_{10}NH_2$, ... $COOH$, ...	Ammonia and isocaproic acid.
Tyrosin, ...	B-oxyphenol-amido propionic.	$CH_2C_6H_4(OH)$, ... $CH_2(NH_2)COOH$	Indol, phenol and skatol.
Aspartic, ...	Amido-succinic, ...	CH_2COOH, ... $CH(NH_2)COOH$	Ammonia and malic acid, then succinic.
Asparagin, .	Amido-succinamic, .	$CH_2CO(NH_2)$, ... $CH(NH_2)COOH$	Ammonia and malic acid, then succinic.
Glutamic, ..	....	$C_3H_5(NH_2)$, ... $COOH$, ...	Ammonia and probably succinic acid.

The amido acids are next decomposed into ammonia and organic acids as shown in the last column of the above table. Tyrosin breaks into indol, phenol and skatol.

Of the basic products of putrefaction we have non-volatile bases known as ptomaines and leucomaines, produced in minute quantities, and certain volatile bases such as monomethylamine and trimethylamine. These latter basic products by further decomposition are converted into ammonia.

From the preceding it is seen that the final products of putrefactive fermentation are ammonia and organic acids. Naturally the organic acids will combine with the ammonia to form salts, but these salts will undergo a still further change in which the acid is converted into carbon dioxide, hydrogen and marsh gas. The two latter escape while the carbon dioxide combines with the ammonia to form carbonate of ammonia. This completes the process, the proteid matter resolving itself into two gases, hydrogen and marsh gas, with a solid residium in the form of ammonium carbonate.

Theoretically this is true, but in reality there remains as a "by-product" of these reactions, as Rideal puts it, "a varying but small quantity of dark pulverent matter resembling the humus or peaty substances of soil."

In addition to this it is known that under certain conditions of exclusion of air, and of the development of the more strongly anaerobic bacteria, a certain amount of the nitrogen escapes in the free state before it is converted into ammonia. While this takes place in putrefying fluids such as sewage it probably does not occur to any appreciable degree in soils.

According to Sommaruga, aerobic bacteria growing in non-saccharine nutrient media always form an alkali from albuminous bodies. These alkaline bodies so far as known are either ammonia or amides, which in part become converted into ammonia. Thus it may be said that ammonia production is almost a universal function of bacteria.

In the following table is shown the production of ammonia by several common species of soil bacteria grown in beef broth at room temperature:

Table III.

	Milligrams of NH_3 per 100 c. c. of Culture produced in			Percentage of the total nitrogen in the medium converted into ammonia in 30 days.
	Seven days.	Fourteen days.	Thirty days.	
Bacterium mycoides,	9.18	20.06	45.50	21.9
Bacillus subtilis,	6.46	18.35	46.20	21.4
Bacillus pulvinatus—				
Variety A,	1.02	10.20	....	....
Variety B,	....	5.78	18.30	8.4
Bacillus No. 6,	0.30	5.44	22.00	10.2
Bacillus No. 7,	2.40	19.72	38.10	17.6
Microspira tenuis,	....	....	....	....
Bacterium fermentationis,	0.30	8.50	27.90	12.9

In the above table it is seen that the highest quantity of ammonia was produced by *Bacterium mycoides* and *Bacillus subtilis*, the latter organism converting 24.4 per cent. of the total nitrogen of the medium into ammonia in thirty days. Both of these species are abundantly and constantly present in soils, and are important factors in the ammonification of organic matter.

It is also noted that there is a marked difference in the ability of the different species studied to produce ammonia, and in the rate of its development; one form *Microspira tenuis* producing none after a period of thirty days. Complete absence of ammonia production is however the exception.

(*b.*) *Nitrification.*

The subject of nitrification is one which has received a large share of attention from scientific men, and the literature thereon is very voluminous, extending over a period of twenty-five years.

In 1871-75, Sir J. H. Gilbert found that the drainage waters from the experimental fields of Rothamsted contained more nitrates as the amount of ammonium salts applied to the soil increased.

In 1878 Messrs. Schlösing and Müntz[25] laid before the French Academy the results of an experiment tending to prove that nitrification was due to the action of an organized ferment. A glass tube one meter long was filled with ignited quartz sand and powdered limestone. Through this sewage was passed at intervals. During the first twenty days the sewage which passed the filter remained unaltered, after which nitric acid began to appear until the filtrate no longer contained any ammonium salt, but only nitrates. Thus it was shown that active nitrification was going on within the body of the filter, and it was suspected that micro-organisms so abundantly present in the same were the active agents of the change.

To demonstrate this point, chloroform vapor, a well-known germicide, was passed through the filter; as a result it was found that ten days after the introduction of the vapor all nitrates had disappeared, and the sewage passed through unchanged. In other words, the chloroform vapor had so paralyzed the micro-organisms present as to completely check the process of nitrification.

Messrs. Schlösing and Müntz were, however, unable to isolate any specific ferment capable of inducing nitrification, and nothing was accomplished toward this end until the year 1886. Celli-Zucco[26] and Heraeus[27] at this time succeeded in isolating from water rich in nitrates a number of forms of bacteria, which, however, only possessed very feeble nitrifying properties.

Frank[28] simultaneously with the latter attempted a similar isolation of the nitrifying organism, but without result, and concluded that nitrification was not due to the direct action of bacteria, but that it was a purely chemical process. This view was opposed by a number of writers, notably, Landolt, Platt and Baumann.[29]

In 1888-89 Warrington[30] and also Frankland[31] studied a large number of soil bacteria, but neither was able to find one which produced any thing approaching active nitrification. Frankland maintained, however, that the nitrifying organism was present, but had not been isolated.

In 1890 Frankland[32] succeeded in cultivating a spherical (coccoid) organism about 0.8 micromillimeters in diameter, which possessed the power of converting ammonium salts into nitrous, but not into nitric acid. The separation was by means of the dilution method in media containing only inorganic salts. In this the form in question grew most successfully.

This fact, and other points in the investigation of Frankland, at once revealed the important principle that the organism of nitrification does not grow normally in media rich in organic matter, and that, therefore, the ordinary method of separation by means of gelatin plates was inapplicable for the isolation of the specific nitrifying agent.

In the same year an identical principle was discovered and put into practice by Winogradsky[33] who succeeded in separating the nitrifying ferment by using a purely inorganic medium containing:

Water of Lake Zurich,	1000 cc.
Ammonium sulphate,	1 grm.
Potassium phosphate,	1 grm.
Basic carbonate of magnesia,	an excess.

In this solution nitrification became very active, when previously inoculated with a small quantity of soil.

By a long series of fractional cultures one was finally obtained which contained but few bacteria except the nitrifying organism. From this somewhat impure culture, gelatin plates were made. On the principle that the foreign non-nitrifying organisms grow in gelatin while the nitrifying bacteria do not, an indirect method of isolation was utilized.

In the portions of the gelatin between the colonies of non-nitrifying bacteria the nitrifying organisms would be liable to be present in a pure state, but unable to produce colonies because of uncongenial soil. By removing bits of this apparently sterile gelatin a few nitrifying organisms, unmixed with others could be transferred to a favorable solution like the one already given. In this way Winogradsky was able to isolate the nitrifying organism.

Later, in 1891, Warrington,[34] in a solution containing mineral salts, obtained, after repeated generation, a culture which nitrified vigorously, and which, by containing no organism which would grow on gelatin, was regarded by him as containing only nitrifying bacteria. The germ thus obtained was an oval form seldom one micromillimeter thick and scarcely longer than broad.

At this time Winogradsky[35] made a decided improvement in the separation of the nitrifying organism from solutions containing it by the use of the Kühne gelatin silica medium.[36] The nutrient basis of this medium as used by Winogradsky was composed of: ammonium sulphate, 0.41 gram, magnesium sulphate, 0.05 grm., potassium phosphate, 0.10 grm., sodium carbonate, 0.6-0.9 grm., calcium chloride a trace, and water 100 cc.

The inoculation of the plates took place either by mixing the inoculating material with the above solution before the addition of gelatinous silica, or it was made as a streak or smear culture on the already hardened material. In this way the nitrifying organisms developed distinct colonies from which pure cultures were made.

The investigations of Winogradsky and simultaneously of Warrington showed:

1. That in the soil the nitrifying process was effected by two distinct but closely related organisms; the one converting ammonia into nitrous acid and nitrate, and the other changing the nitrites into nitrates.

2. That these two processes follow one another in such rapid succession that the production of nitrites is only a transitory phenomenon, so that if both the nitrite and nitrate organism be added to sterilized soil the process is completed in the natural way, only the merest traces of nitrous acid appearing.

The nitrate organism of Winogradsky is an oval form about 0.5 micromillimetres in length. The nitrite germ varies from oval to spherical and is about twice the size of the former. See Figs. 5 and 6.

If to a mineral solution containing ammonium salts, a pure culture of nitrite ferment be added, only nitrites will be formed, and these will remain unchanged in the absence of the second nitric ferment. If, however, the two organisms be added simultaneously, nitrates will be rapidly formed.

In 1892, Winogradsky[37] studied the nitrifying organisms of soil, from a number of different localities. Those from several parts of Europe, from Africa, and from Japan, which he considers to be the same organism, he names *Nitromonas europea;* a second form from Java soil, differing from the first he names *N. javenensis.* Both of these comprise the nitrite ferments of Winogradsky; the second nitrate ferment was isolated by Winogradsky from Quito soil and differs from the first not only as to size, as above mentioned, but also by entirely lacking the motility common to the latter.

The notable researches of Winogradsky have been followed by others which have interest from a controversial standpoint.

In 1895 Burri and Stutzer[38] isolated from soil a nitrate organism with properties akin to the Quito bacillus of Winogradsky. It was a motile organism, 0.75-1.5x0.5 micromillimeters, growing on silica plates in definite colonies, but also possessing the power to grow on gelatin and to liquefy the medium; said organism according to the writer being able to convert nitrites into nitrates, but losing such power when grown on organic media.

The above results of Burri and Stutzer, so contrary to those of Winogradsky, brought forth a vigorous rejoinder from the latter. In this Winogradsky stated that he tested the same earth used by Burri and Stutzer and isolated therefrom his own Nitromonas, and that the latter when tested in bouillon, meat pepton, gelatin and agar failed to grow. He therefore regards the German work as erroneous.

In 1897 Stutzer and Hartleb[40] appeared with a still more startling series of discoveries in which they not only maintained the ability of the nitrifying organisms to grow in organic media, but also showed

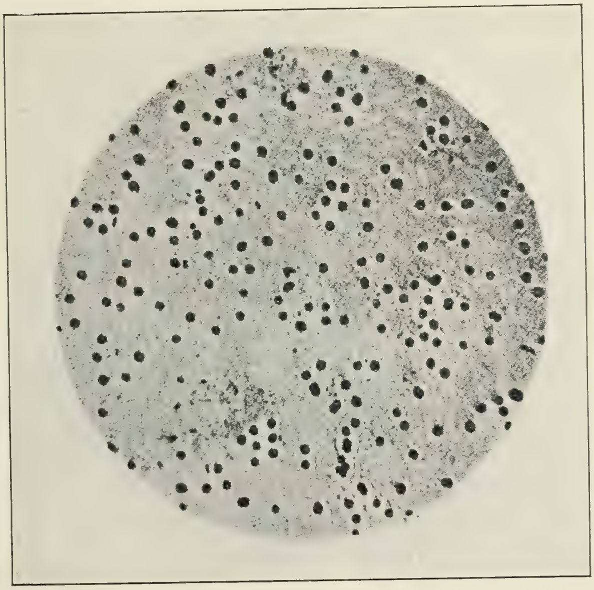

FIG. 5.—The Nitrite Organism of Winogradsky, isolated from Quito earth. Converts ammonium salts into nitrites, the first stage of nitrification. (After Winogradsky: Ann de l' Institut Pasteur, 1891, Plate XVIII.)

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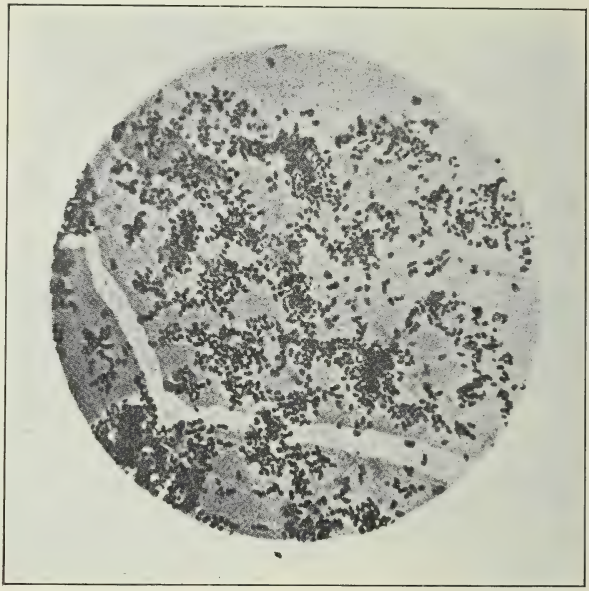

FIG 6.—The Nitrate Organism of Winogradsky, isolated from Quito earth. Converts nitrites into nitrates—the second stage of nitrification. (After Winogradsky: Ann. de l' Institut Pasteur, 1891, Plate XVIII.)

that the latter possessed a polymorphic habit never before imagined in this or any other like group in the whole domain of mycology. The ability of simple coccoid or rod-shaped forms to develop into filaments or even into branched forms, with the further production of true gonidia and other even more highly organized fructification bodies, is a species of morphological transcendentalism likely to cause skepticism.

I will not enter into the details of Stutzer and Hartleb's investigations, as I think we should await further researches before giving them credence. It is easy to believe that the latter's culture, which they claimed to be those of the organism of nitrification, were in reality impure, and that in the variable forms described by them they were in reality dealing with several distinct organisms instead of one.

That this seems true is indicated by the investigations of Gärtner[41] and Fräenkel[42] during the present year.

Gärtner discusses the work of Burri, Stutzer and Hartleb on the polymorphism of the nitrifying organism, and from presumably pure cultures of the latter's nitrifying ferment was able to isolate thirteen different micro-organisms, including a fungus form (Schimmelpilz); thus proving their impure character. Furthermore, Gärtner showed that these several organisms, when once separated in their pure state, retained their fixed character, with no tendency to polymorphism, and indicated none of those transition stages from bacteria to fungi noted by Stutzer. Again none of these isolated organisms possessed the power to convert ammonia into nitrites. C. Fraenkel simultaneously isolated from Burri and Stutzer's cultures II different organisms, including 7 bacilli, 2 streptothrices and 2 fungi (a Fadenpilz and a Schimmelpilz). These showed no polymorphism, but all retained constant characters.

From what has been written there is reason to believe:

1. That nitrification in the soil is caused by a distinct or rather by two distinct organisms possessing certain definite characters.
2. That these organisms will not grow in the presence of any considerable amount of organic matter, and that all reported attempts to cultivate them on ordinary organic media are without authentication.
3. That the above nitrifying organisms are found abundantly in all cultivated soils, and that in ordinary soil water containing, besides mineral salts, a due proportion of ammonium carbonate, sulphate, etc., they find a favorable medium for their development.
4. That the result of such development is: (a) The conversion of ammonia into nitrous acids through the agency of the nitrous organism; and (b), the immediate conversion of the previous nitrous into nitric acid by means of the equally abundant nitric ferment.

Understanding, therefore, that these two stages of nitrification are due to definite organisms in the soil, the laws which control nitrification are simply the laws which control the life and development of said organisms.

If a soil be wet with a one per mille solution of bichloride of mercury, no nitrification can take place; firstly, because the mercury compound has destroyed the life of all nitrifying as well as other organisms, and secondly, because the presence of such a salt in the soil will prohibit the development of all nitrifying ferments which come after.

Again, if a soil be heated above a certain temperature, all nitrifying ferments will be destroyed and nitrification will cease.

Chloroform, formaldehyde gas, sulphurous acid gas, etc., passed through a layer of soil will, on the same principle, prevent further nitrification.

These, however, are all agencies implying the total destruction of the nitrifying ferments. In addition to these there are certain conditions which, while they do not annihilate the life of the nitrifying organism, are yet either favorable or unfavorable to their normal development. These conditions the agriculturist must understand, in order to control the nitrifying process in the soil.

(*c.*) *Conditions Affecting Nitrification.*

Quantity of Organic Matter or Humus in the Soil.

It has already been stated that the nitrifying organism will not grow in a medium containing any considerable amount of soluble organic matter.

When sewage is applied to land nitrification cannot, therefore, begin until after the ordinary putrefying and ammonifying bacteria have decomposed much of the organic matter and rendered the soil water a fit pabulum for the development of nitrifying ferments.

In a 12 per cent. solution of urine, according to Warrington,[43] nitrification did not begin until about ninety days, and then only after 447 milligrams of ammonia per litre had been produced by the decomposition of the organic matter present.

For this reason sewage when applied to land should be used cautiously and not too frequently, otherwise the soil will become so rich in soluble organic matter as to hinder nitrification and thus render the large accessions of nitrogenous food useless.

Thus a soil too rich in humus is an unfavorable nitrifying ground up to the limit when nitrification ceases. Just what this limit is, is as yet unknown. Wiley[44] mentions a soil from Florida containing over 80 per cent. of organic matter, and less than 10 per cent. of sand and other mineral matter, which was found to be entirely free from nitrifying ferments. In ordinary arable land, however, the quantity of organic matter, or humus, never reaches a height sufficient to interfere with the process of nitrification, and hence only in rare exceptions does this factor enter into the question of nitrification.

Aeration and Cultivation.

The nitrifying ferments are what are technically called aerobic, that is, they grow only in the presence of atmospheric air.

Schlösing[45] has determined the rate of nitrification in a moist soil in an atmosphere containing various proportions of oxygen as follows:

1. When oxygen was entirely absent there was a reduction of nitrates and an evolution of free nitrogen.
2. With 1.5 per cent. of oxygen nitrification was marked.
3. With 6 per cent. of oxygen the quantity of nitrate produced was more than double the above (2).
4. With 16-24 per cent. of oxygen the quantity of nitrate produced was more than four times that in (2).

The effect of stirring and pulverizing the soil upon the growth of crops has long been known, and long before the philosophy of the operation itself was in any wise understood.

Among other reasons why cultivation is beneficial is the fact that it aids nitrification by bringing the oxygen of the air into more immediate contact with the nitrifying ferments. The effect of stirring and pulverizing the soil is well shown in an experiment by Deheraine.[46]

Six pots filled with soil, which had remained undisturbed for two years, were selected. Three of the pots had their soil emptied on a clean floor in separate piles, and each lot was kept stirred and pulverized from time to time for a period of six weeks. In three of the pots the soil remained untouched. At the end of the period the nitrates in the several soils were determined, when it was found that the average percentage of nitrates in the three stirred and pulverized soils was 23.7 times that found in the soils which had remained undisturbed in the pots. While it is not presumed that ordinary farm cultivation will produce as marked results as the preceding experiments indicate, it is,nevertheless, clear that the effect of cultivation is to markedly increase nitrification, and in a ratio proportionate to its thoroughness and frequency.

In this principle we have the explanation of why the late cultivation of orchards is inadvisable. Nitrification is more active in autumn than at any other time. This activity would be increased enormously by cultivation, resulting in the production of large stores of nitrates, the bulk of which would be washed out of the soil by the winter and early spring precipitation.

The Presence of Moisture.

Bacteria of all kinds, including the nitrifying organisms, grow only in the presence of moisture. Soil waters, containing dissolved mineral salts and ammonium compounds, are, therefore, the natural media in which the nitrifying ferments develop.

In a dry soil nitrification cannot take place; hence in periods of drouth, where the superficial layers of the soil for a depth of several inches become dry, nitrification is suspended. On the other hand, excess of water prevents nitrification by excluding air, hence water-logged soils must first be drained before they become proper nitrifying beds. In a wet soil not only is nitrification inactive or entirely suspended, but the opposite process of denitrification takes place with the loss of nitrogen in the free gaseous condition.

A soil may be in good condition in its superficial layers, but have an impervious clayey subsoil, which retains the downward drainage; or a still deeper layer of clay may raise the level of ground water so near the surface as to render the subsoil wet. In either case the deeper zones of the soil become too damp for active nitrification, so that this process instead of being carried on from the surface to a depth of about 27-36 inches is confined to a more superficial zone; the elaboration of much valuable plant food is thereby prevented.

The functions of underdrains is thus not only to withdraw the excess of subsoil water, but also by the downward movement of the same to draw air into the soil and thus supply oxygen to the nitrifying ferments.

The Reaction of the Soil.

Nitrification can only take place in a feebly alkaline medium, but the presence of anything beyond a small quantity of an alkaline salt is a hinderance to the process, while a large amount will check it entirely. Thus Warrington[47] showed that the presence of 0.032 per cent. of bicarbonate of soda distinctly retarded nitrification, and that with the presence of 0.096 per cent. nitrification was only barely possible. The same author also showed that the presence of 0.0447 per cent. of ammonia in urine rendered it unnitrifiable. Dumont[48] and Crochetelle showed that carbonate of potash added to soil at the rate of from 1 to 2.5 grams per 1000 grams of soil markedly increased nitrification, but that large applications of the salt progressively diminished the rate of nitrification, and that the addition of 8 grams per 1000 grams of soil completely checked it.

A heavy dose of lime by unduly increasing the alkalinity of the soil may at first check or suspend nitrification until the said lime has been converted into carbonate. This, however, takes place rapidly, diminishing in turn its strong alkaline properties and permitting nitrification to commence more actively than before.

Equally unfavorable to nitrification is an acid condition of the soil. The extreme susceptibility of the nitrifying organism to acid is shown by the researches of Wiley and Ewell.[49] In the experiments of the latter, solutions containing calcium chloride and water were seeded with soil, containing of course nitrifying bacteria. In this medium nitrification continued until the medium reached an acidity equivalent to 4 c. c. of normal acid per 100.

It is a well known fact that nitrification has practically ceased in forest and woodland soils. The same is true, but to a lesser degree, in the soil of old pastures. That such cessation of nitrification is not due to the absence of nitrifying bacteria is shown by the fact that such soils begin to nitrify rapidly upon the addition of some base which overcomes the acidity.

In the experiment of Dumont and Crochetelle, already referred to, a soil which had been in grass from time immemorial and contained 6.84 per cent. of humus was treated with variable amounts of carbonate of potash. It was stirred and watered several times during the experiment. After one month the nitrates were extracted with the following results: Nitric nitrogen, per 1000 grams of soil, without addition of carbonate of potash, 70 mg; with 1 gram of carbonate of potash per 1000 grams of soil, 160 mg; with 2 grams of carbonate of potash, 230 grams; with 3 grams, 250 mg; with 4 grams, 130 mg; with 5 grams, 73 mg.

In an experiment with marsh land containing 5.76 per cent. of humus similar results were obtained, showing that while in the original soil nitrification was practically *nil*, the addition of carbonate of potash resulted in active nitrification.

Too great a degree of alkalinity, as has been already seen retards or entirely checks nitrification.

In a too concentrated solution of urine, the nitrifying process is hindered after a certain time by the accumulation of ammonium carbonate which is being produced by the ammonifying bacteria at a more rapid rate than the oxidation of the ammonia to nitric acid. This is the condition of most stable manures in bulk or before they become intimately mixed through the soil.

The addition of lime to stable manure in a state of ammoniacal fermentation would only still further hinder their nitrification by increasing alkalinity, and would also drive off much valuable ammonia. Lime added to fresh manure before ammonium carbonate has been produced will not cause the above loss of free ammonia, but it will hasten the ammoniacal fermentation so rapidly that nitrification will soon cease.

Both ammonification and nitrification can be made active in a manure heap, when not too closely compacted, or in a soil freshly and heavily dressed with manure, by the use of plaster. Plaster acts by decomposing the excess of ammonium carbonate as fast as formed, producing in turn non-volatile ammonium sulphate, and calcium carbonate (chalk); the latter compound serving as a mild base whose presence is favorable to nitrification.

The loss of ammonia from manure piles is not considerable as long as the latter are kept moist or well compacted. When manure becomes dry, or when the latter is forked over or otherwise kept too loose, a considerable loss of ammonia will result. So far as the loss of ammonia alone is concerned, the application of plaster may not be necessary, but if the latter be spread over the pile with each considerable addition of manure from the stable, its presence will materially aid in the ammonification and nitrification of the same and make it a more active stimulant when applied to the land.

Temperature of the Soil.

Experience at Rothamsted in England shows that nitrification takes place quite freely in the soil during an ordinary English winter. Warrington[50] in one series of laboratory experiments showed a considerable rate of nitrification in solutions kept at the temperature of 37 and 39 degrees F.

According to Schlösing and Müntz, nitrification becomes active at 54 degrees F. and rapidly increases up to 99 degrees F., at which point it is nearly ten times as rapid as at 54 degrees. Above 99 degrees the rate of nitrification rapidly diminishes; at 122 degrees F., very little nitrate is produced, and at 131 degrees F., it ceases entirely.

The Physical Condition of the Soil.

Schlösing has shown that nitrification and microbic combustion in general are less active in fine-grained compact soils than in lighter coarse-grained soils.

A certain proportion of clay and sand appears to be most favorable for a maximum rate of oxidation. In the experiment of Schlösing equal amounts of ammonium sulphate were applied to equal quantities of artificial soil in pots, and the nitrates determined at the end of certain periods; from this the percentage of the ammonium salt which was converted into nitric acid was determined as given in the following table:

Table IV.

	Composition of Soil.		Percentage of the ammonium salt nitrified at 26°-27° C. after 72 days.
	Sand.	Clay.	
Soil No. 1,	100	....	83
Soil No. 2,	90	10	94
Soil No. 3,	80	20	89
Soil No. 4,	75	25	56
Soil No. 5,	70	30	10
Soil No. 6,	100	....	*63
Soil No. 7,	90	10	*66
Soil No. 8,	85	15	*94
Soil No. 9,	80	20	*100
Soil No. 10,	75	25	*21
Soil No. 11,	70	30	*2.7

*Percentage of ammonium salt nitrified after 106 days, temperature of laboratory.

From this table it is seen that the maximum rate of nitrification took place in the soil with a proportion of clay varying from 10-20 per cent. with from 80-90 per cent. of sand respectively, the rate diminishing as it is either lighter or heavier than the above mean. Nitrification, other things being equal, is, therefore, most active in soils which are neither too light nor too heavy.

The soil best meeting these conditions are the sandy loams which occupy an intermediate position between the heavy grass lands of the inner margin of the costal plain and the light truck lands of the seaboard. One way in which soil texture affects rate of nitrification is by its effect on available water.

The finer particles of heavy soils have such a strong attraction for water that a large part of the soil moisture is rendered unavailable for the use of the nitric ferment.

(*d.*) *The Rate of Nitrification in the Soil.*

When samples of soil are taken and kept loosened and stirred, and under favorable conditions of temperature and moisture, the rates of nitrification therein are exceedingly high, as shown by the following Table V[50] from experiments by Lawes and Gilbert:

Table V.

Source of Soil.	Parts of nitric nitrogen produced per day per million parts of air-dry soil.	Period of experiment in days.
Rothamsted soil, first 9 inches,	0.588	119
Do. with ammonium chloride added,	0.944	119
Manitoba soils, Lawes and Gilbert,	0.700	335
Soil, Dehérain,	0.76-1.09	90

The large quantities of nitrates produced in the rich Manitoba soils is due to the relatively large amounts of humus which they contain; the figures for the Rothamsted soil in the same table will, therefore, represent a more normal and average condition.

More detailed figures regarding rates of nitrification are given in Table VI[51] for one of the poorest of the Manitoba soils.

Table VI.

Depths—Inches.	Nitrogen as Nitric Acid Produced per Day During Different Periods of Exposure, in Pounds, Per Acre.						Total nitrogen produced in 285 days.	Total nitrogen per acre in original soil.	Percentage of nitrogen converted into nitric acid in 285 days.
	Periods of Exposure.								
	1st.	2d.	3d.	4th.	5th & 6th.	7th.			
1-12,	0.92	0.88	1.08	1.00	0.36	0.69	227.	5,236	4.78
13-24,	0.17	0.12	0.12	0.52	0.16	0.27	57.2	3,488	1.64
25-36,	0.58	0.49	0.03	0.18	0.03	0.03	43.8	2,592	2.07
37-48,	0.08	0.04	0.01	0.01	0.02	0.02	7.6	870	1.22
							335.6	12,186	

The preceding table shows:

1. That the greater proportion of the nitrates, nearly 65 per cent., are produced in samples from the first 12 inches of soil; both because of the greater quantity of humus in the surface layer and perhaps also because of the greater vigor of the nitrifying ferments in this same zone.

2. That in zones between 12 and 36 inches below the surface large quantities of nitrates can be found, 30 per cent. of the whole, pro-

vided samples from this depth are brought under conditions favorable for nitrification.

3. That at depths greater than 36 inches the proportion of nitrates which can be found is small.

The large quantities of nitrates produced in 285 days, calculated as 335 pounds per acre, in terms of nitric nitrogen, show that our soils when brought under the most favorable conditions for nitrification can be made to produce nitrates at a rate far in excess of the needs of the most exacting crops.

Again, the small proportion of nitrogen converted into nitric acid in a single year, as compared with the total nitrogen of the soil, as shown in the last column of Table VI, demonstrates, furthermore, that virgin soil will at least become abundant sources of nitrogen to growing crops for scores of years.

The question of nitrogen supply in even ordinary soils becomes, therefore, a question of controlling nitrification and of conserving the supplies of nitrates produced by nature. It is not to be supposed, however, that anything like the supplies of nitrates obtained in the preceding experiments can be realized by ordinary tillage to the depths indicated. The production of an amount of nitric nitrogen in any wise approaching 335 pounds to the acre is, therefore, not to be expected. Were it so nature would be most wasteful in her operations, a charge which can never be truthfully brought against her.

A crop of wheat at the rate of 15 bushels of grain per acre will require something like 24 pounds of nitrogen; therefore to produce normal crops the economy of nature would demand that amounts of nitric nitrogen comparable to the actual needs of crops should be produced. This would be true to an approximate degree, provided the roots had complete possession of the land, down to the lower limits of nitrification, and also provided such crops had possession of the land during every month of the year.

In the case of wheat for instance, neither condition holds and consequently the crop being unable at all times to utilize nitrates as fast as they are produced, there must needs be considerable loss.

The fact that the drainage waters from unmanured wheat fields show an amount of nitric nitrogen approximately equal to that used by the crop is an indication that there is produced in the soil each year a stock of nitrates more than double in quantity that which the crop itself can utilize.

The relation between the quantity of nitrogen removed by a crop and that present in the drainage water is brought out in the following Table VII by Lawes and Gilbert. The figures show (1) the number of pounds of nitrogen per acre in crop and in drainage water;

(2) the number of parts of nitrogen in crop and in drainage compared with 100 parts in the manure. These last figures are given in black-faced type. The figures in the last column give the amounts of nitrogen unaccounted for, the plus sign indicating a gain of nitrogen and the minus sign a loss of nitrogen over that contained in the manure.

Table VII.

Plot.	Character of Manuring.	Nitrogen in Manures.	Nitrogen in Crop.	Nitrogen in Drainage.	Nitrogen Unaccounted for.
2 and 4,	Manured continuously,	0 lbs. per acre, **0** per cent.,	12 lbs. per acre, **45.5** per cent.,	15 lbs. per acre, **55.5** per cent.,	+27 lbs. per acre. +**100** per cent.
16,	Unmanured since 1865-1882,	0 lbs. per acre, **0** per cent.,	14 lbs. per acre, **46.6** per cent.,	16 lbs. per acre, **53.3** per cent.,	+30 lbs. per acre. +**100** per cent.
5,	Mixed mineral manures,	0 lbs. per acre, **0** per cent.,	16 lbs. per acre, **48.5** per cent.,	17 lbs. per acre, **51.5** per cent.,	+33 lbs. per acre. +**100** per cent.
6,	Mixed +200 lbs. ammonium salts,	44 lbs. per acre, **100** per cent.,	27 lbs. per acre, **61.3** per cent.,	22 lbs. per acre, **50.0** per cent.,	+5 lbs. per acre. +**11.3** per cent.
7,	Mixed +400 lbs. ammonium salts,	88 lbs. per acre, **100** per cent.,	40 lbs. per acre, **45.4** per cent.,	28 lbs. per acre, **31.8** per cent.,	—20 lbs per acre. —**22.8** per cent.
8,	Mixed +600 lbs. ammonium salts,	132 lbs. per acre, **100** per cent.,	49 lbs. per acre, **37.1** per cent.,	13 lbs. per acre, **32.5** per cent.,	—40 lbs per acre. —**30.4** per cent.
9,	Mixed +550 lbs. nitrate of soda,	86 lbs. per acre, **100** per cent.,	32 lbs. per acre, **37.2** per cent.,	58 lbs. per acre, **67.4** per cent.,	—30.4 per cent. +**46** per cent.
10,	400 lbs. ammonium salts alone,	88 lbs. per acre, **100** per cent.,	14 lbs. per acre, **15.9** per cent.,	50 lbs. per acre, **56.8** per cent.,	—24 lbs. per acre. —**27.3** per cent.
11,	400 lbs. ammonium salts+super-phosphate,	88 lbs. per acre, **100** per cent.,	29 lbs. per acre, **32.9** per cent.,	39 lbs. per acre, **44.3** per cent.,	—20 lbs. per acre. —**22.8** per cent.

The preceding table shows from 50 parts of nitrogen in the drainage as compared with 61.3 parts in the crop up to 67 parts in the drainage as compared with 37.2 parts in the crop.

The table also shows that in the case of wheat the greater proportion of the nitrates in the soil are either beyond the reach of the roots, or what is more probable, that they are washed out of the soil at that season, fall or winter, when the wheat has but limited capacity of absorbing them. For this reason wheat is shown to be one of the most exhaustive of all farm crops as regards nitrogen supply. That no such proportionate loss of nitrates occurs with other crops, like grass and clover, which cover the ground especially during the fall and winter months is shown by numerous figures, some of which will be considered under the head of loss of nitrates.

(*e.*) *Losses of Nitrates.*

Relation to Rainfall and Percolation.

Nitrates are easily leached out of the soil and carried into the drainage. In a highly porous, sandy soil free of vegetation, the greater proportion of the annual rainfall, 80 per cent. more or less, will pass downward through the soil and appear as drainage.

In land covered with a sod a much less percentage, about one-third of the rainfall, may pass off as drainage, the remainder being evaporated or thrown off by the plants in transpiration.

In a plot of fallow ground at Rothamsted[52] for a period of 28 years the annual average outflow of drainage was 11.76 inches and the average rainfall for the same period 28.3 inches, making the average percentage of drainage 41.5 per cent. of that of the rainfall.

The action of vegetation in preventing an excessive outflow of drainage is most evident during the months of maximum growth May to September, as the following figures by Greaves and Evans[52] indicate:

	Rainfall—Inches.	Drainage.	
		Inches; Sand.	Inches; Sod.
January,	2.87	2.73	2.03
February,	1.59	1.52	1.08
March,	1.93	1.60	0.88
April,	1.43	1.12	0.27
May,	2.05	1.65	0.10
June,	2.20	1.57	0.15
July,	1.77	1.21	0.01
August,	2.33	1.78	0.11
September,	2.35	1.74	0.07
October,	2.73	2.40	0.51
November,	2.02	1.96	0.83
December,	2.42	2.17	1.51
Total,	25.7	21.5	7.6

It is evident that the larger the rainfall the greater will be the amount of drainage, and the greater *pari passu* the loss of nitrates. Another factor also governs the amount of nitrates in the drainage, and that is the quantity of nitrogen in the soil, particularly in its soluble form.

The application of considerable quantities of ammonium salts or of nitrates as fertilizers, or of nitrogenous manures as stable manure or rape cake, results in a large increase of nitrates in the drainage. These facts are brought out in the following table from Lawes and Gilbert:

Table VIII.

Nitrogen as Nitrates in Drainage Waters, Broadwalk Field at Diferent Seasons. Average of three Years in parts Per Million of Drainage Water.

Plot.	Spring sowing to end of May.	June to harvest.	Harvest to autumn sowing.	Autumn sowing to spring sowing.	Whole year.	Nitrogen per acre per inch of drainage.	Character of the Manuring of the Land.
5, ...	2.9	0.2	4.8	5.5	4.2	0.95	Mixed mineral manures.
6, ...	14.7	0.7	6.0	5.4	5.4	1.22	*200 lbs. ammonium salts and minerals.
7, ...	27.1	1.4	7.3	5.4	6.8	1.54	*400 lbs. ammonium salts and minerals.
8, ...	28.2	4.0	13.5	7.5	9.3	2.10	*600 lbs. ammonium salts and minerals.
15, ...	6.7	2.9	7.5	28.1	19.3	4.37	†400 lbs. ammonium salts and minerals.
17, ...	29.7	1.8	6.6	5.5	7.1	1.61	400 lbs. ammonium salts alone.
18, ...	1.5	0.3	5.6	5.5	4.3	0.97	Mixed mineral manure.
2, ...	3.6	1.4	6.0	9.5	7.5	1.70	Barn yard manure.
19, ...	3.7	0.5	7.0	14.0	10.4	2.35	Rape cake.

*Applied in the spring.
†Applied in the fall.

The use of large quantities of ammonium salts, or of nitrate of soda at the time of spring seeding results, as the last table shows, in an immediate increase of nitrates in the drainage waters.

There is every reason to believe that ammonium salts, when applied to the soil, are very rapidly converted into nitrates, and in this form washed out of the soil. The same loss would follow similar applications at the time of autumn sowing as shown by the results from Plot 15, given in the last table.

Hence whenever it becomes necessary to use ammonium salts or nitrates as a crop stimulant, they should be applied in small quantities while the crop is growing. The custom of introducing nitrate of soda with the seed is accordingly a most wasteful operation.

The Amounts of Nitrates Lost in the Drainage.

It is calculated that the River Rhine discharges daily into the ocean 220 tons of nitrates, calculated as nitrate of soda; the Seine 270 tons, and the Nile 1,100[53] tons.

Since the great bulk of this comes from nitrates produced in the soil it is easy to form some idea of the tremendous losses of this the most valuable of all plant nutrients.

From what has already been said it is seen:

1. That given equal rainfall, the amount of nitrates lost in the drainage is greater in sandy than in heavy soils; and in direct ratio to the porosity of the latter.

2. That the loss by drainage, and hence the corresponding loss of

nitrates, is diminished by vegetation; hence in fallow land the loss of nitrates is greater than in land covered with plant growth.

Thus from an unmanured field at Rothamsted, kept fallow and free of weeds, the loss of nitric nitrogen per acre per annum was for three successive years 38.9, 48.3 and 27.4 pounds respectively, while from an experimental wheat field at the same place the similar loss, as an average of 19 years, was in one case 9.1 and in the other 11.9 pounds per acre[52] per annum.

The Effect of Mineral Fertilizers on the Loss of Nitrates and on Nitrification.

I have already mentioned the effect of lime and plaster on nitrification; still another point needs mention.

The nitrifying organism cannot multiply except in the presence, among other elements, of phosphoric acid and potash. Nitrification is, accordingly, aided by applications of mineral fertilizers.

The effect of potash salts alone, or of potash salts mixed with carbonate of lime, in increasing nitrification and ammonification in soils rich in humus, has been shown by Dumont.[54] In soils differently treated the amount of nitric nitrogen produced in 1000 grams of soil in 40 days was in milligrams as follows:

Check,	2.8
Potassium carbonate, 0.1 per cent.,	57.8
Unleached ashes, 0.5 per cent.,	19.0
Muriate of potash, 0.1 per cent., and carbonate of lime, 2 per cent.,	38.0
Muriate of potash, 0.1 per cent., and Thomas slag, 5 per cent.,	41.5
Carbonate of lime, 2 per cent.,	5.3

From the preceding it is seen that a marked increase of nitrates resulted when some form of potash was used. In the mixture of muriate of potash and carbonate of lime, a double reaction between the two took place, producing carbonate of potash and chloride of calcium. The author claims that the action of the potash salts is to combine with the humates of the soil and form a compound which is very readily nitrifiable.

Again, the ability of a crop to utilize the nitrates of the soil is considerably diminished when there is a deficiency of available mineral constituents, especially of potash and phosphoric acid.

The effect of mineral salts upon nitrification and the loss of nitrates is well shown in the following table:[53]

Table IX.

Nitrogen as Nitrates in Soil and Subsoil and in the Drainage Water of Various Plots in the Broadwalk Wheat Field, in Pounds Per Acre.

Plot.	Nitric Nitrogen in the Soil—Pounds Per Acre.				Nitric nitrogen removed by drainage Aug. 30-Jan. 31—lbs. per acre.	Percentage of total nitrogen of soil removed by drainage.	Character of Manuring.
	1st—9 inches.	2d—9 inches.	3d—9 inches.	Total 27 inches.			
2,.......	9.7	5.3	2.8	17.8	11.6	65.1	Unmanured.
5 a,.....	12.6	7.1	4.6	24.3	13.2	54.3	Mixed mineral manure.
10 a,.....	14.2	11.9	7.3	33.4	31.1	93.1	400 lbs. ammonium salts.
7 a,.....	22.3	11.3	5.7	39.8	24.1	60.5	do. + mixed minerals.
11 a,.....	17.9	9.3	3.6	30.8	27.5	89.2	do. + super-phosphate.
8 a,.....	21.1	13.9	7.8	42.8	30.1	70.3	600 lbs. ammonium salts and mixed minerals.

From the above we note that the total nitric nitrogen in 27 inches of unmanured soil was 17.8 pounds per acre; while in the same soil, treated with mixed mineral fertilizers, the amount was 24.3 pounds per acre.

The percentage of nitric nitrogen which passed out in the drainage was also diminished as a result of the application of mineral fertilizers.

The effect of mixed minerals, when applied with ammonium salts in diminishing the loss of nitrates in the drainage, is well shown in the results from Plot 10a, 7a, and 8a, in the preceding table.

The Effect of Season of Year Upon Loss of Nitrates.

The preceding table shows that in unmanured land, and in land to which only mixed fertilizers, free from nitrogen, had been applied the percentage of nitric nitrogen removed by the drainage from September 1 to February 1, five months, was from 54 to 65 per cent. of the total quantity present in the first 27 inches of soil at the beginning of the experiment. In Table VIII similar results are observed.

On Plot 5, fertilized by non-nitrogenous manures, the average number of parts of nitrates per million parts of drainage for the whole year was 4.2 while the corresponding figures for the periods from wheat harvest to autumn sowing, and from autumn sowing to spring sowing, were respectively 4.8 and 5.5. The corresponding figures for the periods from spring sowing to the end of May, and from June to harvest, were 2.9 and 0.2.

The losses of nitrate in a wheat field, or on fallow ground are therefore greater during the fall and winter months; and least during the summer months.

The increased loss of nitrates in a wheat field during the fall and winter months is due to a combination of causes:

1. Diminished evaporation and increased drainage.
2. The accumulation of nitrates in the soil during the summer months beyond the needs of the plants, which are washed out of the same during the fall and winter, and
3. The inability of wheat at this season to utilize the soil water and prevent excessive percolation.

These considerations teach a most important principle, i. e., that ground should be kept in some crop as much of the time as possible especially during the fall and winter. The growth of wheat as one crop in a system of rotation is of course necessary, notwithstanding the inevitable losses of nitrates which follow its seeding.

There are, however, certain violations of the above rule which need correction.

Corn land should never be left fallow through the winter. The same is equally true of tomato and trucking land. Either these crops should be followed by wheat or some winter cover crop put in to conserve nitrates. In a loose sandy soil in which it is more difficult to accumulate available nitrogen it would be inadvisable to follow a cultivated crop like tomatoes, or potatoes by wheat, but rather to use crimson clover or rye to hold the nitrogen.

(*f.*) *Increasing the Supply of Available Nitrogen in the Soil.*

Soils may become too rich in humus and available nitrogen. The use of crimson clover has in some cases in Delaware been carried so far as to work actual injury to the land, especially if the latter has a tendency to become heavy and retentive of nitrates. The majority of farm lands, however, are not open to the charge of being too rich; on the contrary, the improvement of land and the growth of larger crops is the great desideratum.

I have already pointed out that most soils contain large supplies of organic nitrogen, which, by the aid of nitrification, can be made available to crops. The question of utilizing these stores of organic nitrogen already in the soil becomes mainly one of underdraining, deep plowing and more frequent cultivation.

Every cultivation of a corn or potato crop is equivalent to a dressing of nitrate of soda in its cheapest possible form. Hence if we could cultivate twice to each once by our present system we would considerably increase our supplies of available nitrogen, and in turn reap the rewards of such an increase in larger crops.

Such a system of intensive cultivation carried on year after year would, however, result in the burning out of the land, and in greatly reducing the fertility. It is, therefore, necessary to make good these losses of organic nitrogen by the growth of such crops, or by the use of animal manures, as shall add to the stock of humus already in the soil. The effect of stable manure and clover in increasing the quantity of nitrates in the soil is brought out in the following table:[31]

Table X.

Nitrogen as Nitric Acid in Pounds per Acre in Soils of Geescroft and Hoosfield Experimental Plots, Rothamsted.

Depth—Inches.	I.	II.	III.	IV.
	Geescroft field, land in beans 30 years continuously, then 4-5 years fallow without manure.	Geescroft field as in I. Farmyard manure.	Hoosfield, wheat and fallow alternately for 35 years.	Hoosfield, 17 years in clover, 12 years fallow and six crops grain in 35 years. No nitrogen manure.
1-9,	4.28	13.57	19.85	30.90
10-19,	5.52	8.76	8.05	27.73
19-27,	4.81	7.70	2.47	8.44
28-36,	2.69	8.51	2.70	7.64
37-45,	2.68	4.36	1.62	9.07
45-54,	1.90	1.85	3.57	8.77
55-63,	2.60	1.71	3.84	7.92
64-72,	3.47	—4.00	2.28	8.34
Total,	27.95	50.46	44.38	108.81

The results given in column I are from a field left for 30 years unmanured and exhausted by continuous cropping to beans, followed by fallowing. In column II it is seen how, even under condition of the most heavy drain upon a soil, the supply of available nitrogen can be maintained by the use of stable manure.

In columns I and II above, the comparatively large quantities of nitrates in the lower zones of the soil will be noted as indicative of the effect of excessive downward percolation during 4-5 years of fallowing; for this reason the soils of the Geescroft field are really poorer in available nitrogen, within that zone occupied by the bulk of the roots, than the amount of total nitrogen to a depth of 72 inches would indicate.

In column III the effect of 35 years' continuous culture of wheat on the same land is shown; the result is a soil richer in available nitrogen than might be expected.

The comparative effect of 17 years in clover, as shown in the last column, is a marked increase of available nitrogen, and shows the good effect of such crops in increasing the store of this important element of plant food.

The effect of permanent grass in increasing the store of nitrogen in the soil is marked, and is well brought out in the following table by Sir. J. B. Lawes:[55]

Table XI.

Nitrogen in Surface Soil (dry), First 9 Inches, and Gains in Pounds Per Acre in Land in Permanent Grass.

Dates.	Number of years.	Nitrogen.	Gain.	
		Per acre—total lbs.	Per acre—total.	Per acre—per annum.
1856,	....	3,040	....	....
1866,	10	3,497	....	....
1879,	13	4,091	457	....
1888,	10	4,690	594	45.7
			599	59.9
Total,	33		1,650	50.0

It should be understood that the above field has been mowed for hay every year for 33 years, with average yield of 1.7 tons per acre per annum, and yet, notwithstanding this annual drain, there was an increase of nitrogen in the soil of 50 pounds per acre per annum.

Thus the state of knowledge is sufficient to indicate that all soils can be kept sufficiently rich in available nitrogen by the judicious use of leguminous crops in a proper system of rotation, or by the use of grass and clover as a part of the same system, and this without the necessity of purchasing a single pound of nitrogen in a fertilizer.

6. Denitrification and Loss of Free Nitrogen.

Through the agency of bacteria present in all soils, nitrates under certain conditions may be converted into lower oxides of nitrogen, into ammonia or into free nitrogen.

Goppelsröder,[56] in 1862, made the observation that in soils rich in humus active denitrification took place.

In 1882, Gayon and Dupetit[57] found that in river water containing small quantities of nitrate of potash (0.02-0.2 grams per 1000) there was a reduction of the latter salt to ammonia.

The reduction of nitrates through the agency of bacteria was later (1883) observed by Dehérain and Maquenne,[58] and also by Springer,[59] which reduction they held to be due to the agency of anaerobic forms, similar to B. *butyricus*, which either reduced the nitrates to lower oxides of nitrogen or to free nitrogen.

Heraeus,[60] in 1886, isolated from water two bacilli which posessed to an eminent degree the power of reducing nitrates to nitrites. Blasi and Fravoli,[61] in 1888, found in Palermo soil 27 different species, which they have studied as to their chemical action in gelatin containing nitrates. They found that in 1-3 days the quantities of nitrates diminished with a simultaneous increase of nitrites. These latter reached their maximum in 6-8 days, and after 25-30 days entirely disappeared.

Frankland,[62] in 1888, isolated from water some 32 different species of bacteria, of which no less than 17 possessed the power more or less completely of reducing nitrates to nitrites. Of these the most strongly reducing were B. *ramosus* and B. *pestifer*.

Bréal,[63] in 1892, isolated from straw and other refuse a ferment which possessed strong reducing action. He found that if to straw fermenting in water, nitrates were added, the latter rapidly disappeared, while if sterilized straw were put into water and allowed to ferment, no such reduction took place, thus showing the presence upon the straw of some specific denitrifying organism. The nitrogen, according to the author, appeared partly in organic combination and partly as elementary nitrogen.

Gilthay and Aberson,[64] in 1892, isolated from both soil and atmosphere two organisms which possessed active powers in reducing nitrates, and which they named *Bacillus denitrificans* var. a. and b. Both of these liberated free nitrogen.

Egunow,[65] in 1893, isolated from the surface of seed a bacillus which possessed the power of reducing nitrates to nitrites, etc. Egunow found that in flasks with broad flat bottoms, with mineral media and nitrates, and with the fluid only a few millimetres thick, the nitrates were finally converted into ammonia. Where the thickness of the fluid was 10 mm., the nitrates were converted into ammonia and free nitrogen. Where the thickness was 60-70 mm. no ammonia was formed, but only free nitrogen.

Burri, Herfeldt and Stutzer,[66] in 1895, isolated from horse manure and from straw two bacilli, respectively B. *nitrificans* I and II, which actively reduced nitrates.

Schirokikh,[67] in 1893, isolated from horse dung a bacillus which liquified gelatin, and actively reduced nitrates. In broth containing 2.5 grams of potassium nitrate to the litre, the latter was completely reduced in 5.8 days, at a temperature of 30-35 degrees C.

Again, Sewerin,[68] in 1897, isolated from horse manure 29 species of bacteria, of which 20 possessed greater or less power of reducing nitrates.

In 1896, Richards and Rolfs[69] conducted some experiments with 25 different solutions prepared to typify conditions of water polluted with decaying organic matter (sewage), and at the same time containing nitrates.

They note, (1) the rapid disappearance of nitrates, usually less than 10 per cent. of the original quantity remaining at the end of 3 days; (2) a corresponding increase of nitrites; (3) that when the solutions contained no organic matter other than that usually present in the water reduction took place very slowly and incompletely; (4) that the nitrogen which disappeared from the nitrates was finally given off in the free state; (5) that whenever nitrates were added to decomposing organic matter under such conditions that the growth of the bacteria required more oxygen than the solution afforded, the latter took it from the nitrates setting free nitrites, which in time were decomposed, setting free nitrogen.

From the aforegoing citations it is seen that denitrifying bacteria are abundantly distributed in nature, and that they are found in water, soil, manure, sewage and upon the surface of plants, particularly upon straw. It is only necessary to add a small portion of soil to media containing nitrates to obtain active denitrification thus showing the general presence of denitrifying bacteria in soils.

The majority of soil bacteria studied separately by the author possess this property to a greater or less degree.

7. Conditions Affecting Denitrification.

(*a.*) *Presence or Absence of Air.*—It has commonly been supposed that the power of reducing nitrates belongs more exclusively to the anaerobic bacteria, or those which live without air. The question is an open one as to how far denitrification is the result of a deficient supply of atmospheric air. All of the species of soil bacteria so far examined by the writer, with one exception, are aerobic, and yet they all actively reduce nitrates.

That active denitrification can take place in the presence of an abundant supply of atmospheric oxygen is shown by the following: A culture of B. *pulvinatus* was selected on account of its active denitrifying properties.

The bacillus was grown in a solution of Witte's peptone containing one gram of nitrate of soda to the litre.

Provisions were made for continually passing sterile air through the culture so as to provide an abundance of atmospheric oxygen. Simultaneously with the above, a culture was made in an ordinary flask, plugged with cotton wool, without aeration. At the end of 5 days 7.0 milligrams of nitrite of soda per 100 c. c. were found in the aerated culture and 30.0 milligrams in the non-aerated.

At the end of 10 days 20 milligrams of nitrite of soda were found in the aerated and 40 milligrams in the non-aerated culture.

In this case active denitrification took place even with abundant and continual aeration of the culture, although the presence of large quantities of atmospheric oxygen seemed to somewhat retard the process.

These results are in conformity with those of Stutzer and Maul.[70] B. *denitrificans* and B. *coli-communis* in a broth culture caused a vigorous reduction of nitrates to nitrites, and in four days the nitrites had entirely disappeared, when, however, a constant stream of air was passed through the culture, growth took place as before but the nitrates had not entirely disappeared until after the tenth day.

It would, therefore, appear that denitrification can take place actively even in the presence of an abundant supply of atmospheric oxygen, certain bacteria at least being capable of utilizing combined oxygen equally with that supplied in the free state.

Contrary results were obtained by Pfeiffer, Franke, Götze and Thurmann[71] in their study of the loss of nitrogen in manures. They found that denitrification was more active when air was drawn through and over the manure than when air was excluded, the presence of atmospheric air apparently favoring the process, and it has become a recognized principle that manures lose nitrogen less readily when kept closely compacted than when loose.

(*b.*) The Presence of Organic Matter.

The effect of organic matter upon the development of the denitrifying organism was shown by Stutzer and Jensen in 1897.[72] The experiments of the latter indicate that denitrification can take place only in the presence of a sufficient supply of assimilable carbon, otherwise the nitrates remain unaltered although the denitrifying organism may be present in abundance. Apropos to this principle the authors hold with Maercker that horse manure is more active in causing denitrification than sheep or cow manure since the former is much richer in assimilable carbon than the latter.

It is a well known fact that denitrification is particularly active in stable manure, and denitrifying bacteria are especially abundant therein. The admixture of straw also favors the denitrification process, and an explanation of this has been found in the fact that straw contains an easily assimilable carbon in the form of pentosans. The pentosans which are abundant in coarse manure and straw, furnish a much more readily available food to denitrifying organisms than cellulose or fibre. Still more readily assimilable forms of carbon are found in such compounds as glycerin, citric acid, lactic acid, etc., and Pfeiffer and Lemmermann found that the denitrification process in manure was accelerated by the addition thereto of a soluble calcium citrate.

The loss of nitrogen in the free state in organic infusions seems to be associated with the presence of readily decomposable nitrogenous bodies, such as the *amides.* Thus Grimbert [72.5]found that the colon bacillus, when grown in a solution containing peptones and nitrates, yielded no free nitrogen, but when grown with nitrates in a solution made from beef extract and containing amides there was a considerable loss of nitrogen in the free state.

The author, therefore, concludes[1] that the nitrogen does not come exclusively from the nitrates, but also results from the denitrifying action of the bacillus upon amido principles in the culture medium.

2. That the evolution of free nitrogen seems to result from the secondary reaction which nitrous acid, formed by the bacteria, exerts on these amido substances.

It has been seen that one step in putrefaction and ammonification is the production of amido acids and basic amines, and this explains perhaps the rapidity of the denitrifying process in infusions rich in nitrogenous organic matter which are undergoing putrefaction.

Kinger[73] showed that when nitrate of soda was mixed with liquid manure (urine) there was a decided decomposition of nitrogenous compounds and loss of nitrogen. And in the same connection, T. B. Wood[74] found that nitrate of soda when used alone as a fertilizer for oats gave much better results than when used with manure.

This simply reiterates the former principle that nitrates readily decompose in the presence of an excess of readily assimilable organic matter.

(*c.*) The Relation of Denitrification to Cultivation.

It has been stated that denitrification may take place either in the presence or absence of atmospheric air.

With the presence of some form of easily assimiliable organic matter, it may take place under any condition of aeration.

Nitrification is the opposite and antagonistic process to denitrification. Furthermore, the conditions which are favorable to the former are inimicable to the latter.

The question of denitrification and loss of nitrogen in soils is one about which much has yet to be learned, but it is generally believed that under ordinary conditions it is of no particular importance. At least this much may be said, that if the agriculturist will maintain those conditions which are favorable to nitrification, any possible loss of nitrogen by the opposite process can be disregarded.

Hence cultivation, which effects the rapid destruction of easily assimiliable organic compounds, leaves little opportunity for the denitrifying bacteria to carry on their destructive work.

8. The Loss of Nitrogen From Stable Manures and its Conservation.

It has been stated that denitrification and loss of nitrogen is comparatively rapid in stable manures, because of the abundant presence of denitrifying bacteria and of easily assimiliable organic compounds which furnish food to the latter. It has also been noted that straw mixed with urine and excrement also assists the process by furnishing an easily assimiliable carbon compound in the form of pentosans.

So deleterious is the action of straw that it has been suggested, as a feature of good farm practice, to keep the manure and litter separate, or to see to it that as little straw as possible becomes mixed with the urine and faeces.

To what extent this is practicable must be left to the practical agriculturist to determine. But taking conditions as they ordinarily exist, i. e., with straw forming a considerable proportion of the manure proper, and with the natural losses of nitrogen which must take place to confront us, how can these be reduced to the minimum.

There are two methods for conserving the nitrogen content of stable manure, first, by the exclusion of air and second, by the use of preservatives.

Regarding the first method it has been shown that denitrification is more active when air was drawn through and over the manure than when it was excluded.

Under the former condition of free access of air Franke, Götze and Thurman[71] showed a loss of nitrogen amounting to from 27.6 to 42.6 per cent. of that originally present.

Hence to prevent loss of nitrogen the manure should be kept well compacted; its storage in sheds, or even in closed receptacles, whereby it is protected from strong currents of air, is also advisable.

The preceding authors have also made valuable experiments on the use of preservatives. Of these, the use of super-phosphate is especially recommended.

In this case the transformation of the nitrogen in the form of free ammonia into free nitrogen was prevented by the use of a sufficient amount of the super-phosphate to combine with all the ammonia formed, thus fixing it and preventing its loss. Plaster or sulphate of lime acts in the same way but less energetically.

The addition of 2-3 per cent. of caustic lime, or 5 per cent. of marl, decidedly reduced the denitrifying power of fresh manure.

The use of caustic lime, however, is not to be advised as it was found to promote ammoniacal fermentation, and the loss of ammonia.

According to the authors, the mechanical condition of the manure exerted a more marked effect upon its preservation than chemical preservation. Hence the keeping of the manure in a well compacted condition and free from strong currents of air is of primary consequence.

9. The Disintegration and Dissolution of Mineral Matter.

This subject has, in a measure, been discussed in previous pages, but a few additional statements, in this connection, might be made.

The mineral elements of plant food are absorbed in the form of salts. These salts are compounds of acids and bases, as shown in the following list:

Plants Absorb.

Acids.	Bases.	As Salts—i. e.		
Nitric,	Ammonia,	Nitrates,	of	Ammonia.
Sulphuric,	Potash,	Sulphates,		Potash.
Carbonic,	Lime,	Carbonates,		Lime.
Phosphoric,	Iron,	Phosphates,		Iron.
Silicic,	Soda,	Silicates or		Soda or
Hydrochloric,	Magnesia,	Chlorides,		Magnesia.

Of these acids, certain of them have existed in the rocky crust of the earth, from which soils have originated, before the advent of life, and hence are not of bacterial origin. These are sulphuric, phosphoric, silicic and hydrochloric acids. Others of them are products of bacterial life such as carbonic and nitric acids.

Of the bases, all except ammonia are of primordial or earth crust origin.

Of the salts, the sulphates, silicates, carbonates and chlorides, which are largely present in rocks, are not absorbed except in minute quantities, the greater part of the bases being taken up as nitrates and phosphates, and also as salts of the organic acids.

In the process of nitrification the nitric acid combines with the various bases present in the soil, and nitrates are produced.

Phosphoric acid exists in the soil in the form of insoluble basic phosphates, which, under the action of organic acids, are converted into neutral or acid salts which are soluble. Hence the production of organic acids by bacterial fermentation renders phosphoric acid available to plant roots.

We have already spoken of the action of carbonic acid, in disintegrating, and setting free as carbonates, the various bases locked up as mineral silicates. These carbonates unite with silica to form zeolites and these in turn are slowly decomposed by organic acids, and their contained bases again liberated as organic salts.

H. Carrington Bolton has shown that many minerals are slowly decomposed by the action of cold citric acid, the zeolites and other hydrous silicates being especially susceptible.

Thus by the combined production of carbonic, nitric and the various organic acids, through the action of bacterial life, we have all the necessary agencies at hand for the dissolution of the mineral elements of plant growth.

VIII. THE ASSIMILATION OF ATMOSPHERIC NITROGEN.

1. Historical Summary.

The Biology of Root Tubercles.—It is a fact familiar to all that the roots of leguminous plants contain nodular swellings or excrescences known as "root tubercles."

These have been recognized from the earlier days of botanical inquiry, and as far back as 1615, DeLéchamp used the characters of the root tubercles as a basis of classification, and the same use was made of them by DeCandole[75] in his System of Vegetation.

At different periods during the earlier part of the nineteenth century various opinions were held by different authors regarding these bodies. The more general view was that they were of the nature of fungus growths, or otherwise diseased conditions of the roots; a few held them to be the result of animal parasitism, and due either to insects or worms; while others considered them to be normal organs, regarding whose function there was difference of opinion.

All of these latter views were, however, purely speculative, rather than based upon any serious study; and it was not until 1866 that any attempt was made to study them closely; when Woronin[76] described their microscopic structure.

He found them to be composed of a central portion of thin walled cells, of an outer rind, and of an intermediate layer or vascular ring. In the central portion the contents were cloudy, and closer examination showed the cells in this portion to be filled with peculiarly shaped bodies, which were sometimes rod-like, at others forked, and presenting a variety of forms simulating the letters T and Y. Woronin regarded these bodies as living organisms, but since they differed from other bacteria or *Vibros* in form, he termed them *Bacteroids.* He regarded them as the causative agents in the formation of the tubercles, although he offered no proof of this assumption.

In 1874, Erickson[77] found in the newly developing tubercles long branching filaments resembling the mycelium of a fungus.These threads he considered to be the infecting agents. Later on in the development of the tubercles he observed the presence of the bacteroids, noted by Woronin, but failed to connect the two as corelated structures.

In the early observations of Woronin and Erickson we have the germ and substance of all that has since been discovered regarding root tubercles. Both recognized, as is held to-day, the two classes of bodies the filamentous and the bacteroid. Both were right in assuming that the organisms as seen within the tubercles were the agents in their production, although Erickson was more nearly right in assuming that the filaments were the real infecting agents.

But it was left to others to show the relation of the filaments to the bacteroid bodies, and this question became the subject of much controversy and difference of opinion extending over many years. In the controversy which followed, covering the latter 25 years of the nineteenth century, the most eminent botanists were engaged.

On certain points they agreed, on others they differed, but since the points on which they differed determined the position which these forms should occupy in a system of classification, the subject became of especial interest.

All agreed to the presence of the filaments within the tubercles in the early stage of their development. These filaments were furthermore regarded as the infecting parts, which forced their way into the younger roots and, by their iritating presence, set up a multiplication or proliferation of cells which resulted in the building up of an excrescence or tubercle.

It was upon the structure of the filaments, and upon how the bacteroid bodies originated from them, that they differed, and upon this point it is surprising that there should havebeen such a wide diversity of view. These two views class themselves under two heads, which, for the sake of convenience, we shall term the endogenous and the exogenous theories. The former was held by Prazmowski, Frank and Maria Dawson, and the latter by Laurent, Ward and Atkinson.

According to Prazmowski,[78] the leader of the endogenous theory, the infecting agent in the production of the root tubercles is present in the soil as a definite bacterium, which, after Beyerinck, he calls *Bacterium radicola.*

Certain of these force their way into the smaller roots and for a time multiply therein; but soon the juices of the plant exert an unfavorable influence upon them, and to protect themselves against its injurious action they excrete a gelatinous substance in which they remain embedded, and in which they continue to multiply. With this multiplication the gelatinous envelope is drawn out into long strands or filaments, containing the rod-shaped bodies or bacteria. As long as these remain protected by their gelatinous envelope they continue to multiply and retain the rod-shaped form.

As the filaments approach the central portion of the tubercle they swell out into rounded vessicles. Later on by the enlargement of these latter the enveloping membrane becomes so thin that it bursts and the enclosed bacteria are set free. From this time they cease to multiply, and by degeneration assume a variety of irregular branched forms, first observed by Woronin, and called by him bacteroids. Prazmowski, therefore, recognized (1) that the filaments were elongated pouches of gelatinous matter, the secretion of the bacteria, and in which the infecting bacteria were embedded; (2) that these bacteria multiplied as straight rods within the filaments, or endogenously; (3) that by the escape of the bacteria they underwent various degenerations by which they assumed the irregular forms of bacteroids.

One essential point in Prazmowski's position was that the bacteroids were degenerated forms.

Frank[79] in his later observation, held to the position of Prazmowski, but differed in regarding the gelatinous envelopes as a product of the cell rather than of the bacteria.

Maria Dawson[80] in 1899, also held to the view of Prazmowski. By proper staining she found the filaments to consist of strands of straight rodlets lying parallel to the longer axis of the filaments and embedded in a colorless matrix. This matrix did not consist of cellulose, chitin, or any form of slime. The swellings, or vessicles of Prazmowski, occurred at places where the rodlets had become heaped up and eventually had burst liberating the rodlets. After liberation from the filaments they became transformed into X, V and Y shaped bacteroids.

The exogenous theory is best represented by the researches of Laurent in 1891,[81] and later by those of Atkinson in 1893.[82]

Both hold that the filaments are not pouches containing bacteria, but true homogenous filaments, which, as they enter the cells of the central portion of the tubercle, show enlargements which afterwards, by a process of budding, give rise to the branched bacteroid bodies.

This view was also held by Ward[83] somewhat earlier, and all agree in regarding the organism as a lowly organized fungus instead of a bacterium whose filamentous portion corresponds to the mycelium, and whose bacteroids are buds or gonidia thrown off from the latter. For this fungus, Laurent adopts the name *Rhizobium leguminosarum* originally proposed by Frank.

Regarding these two views the bulk of evidence inclines to the exogenous theory, although there is opportunity for further study before the matter is finally settled.

In what has been already said it was assumed that the root tubercles of leguminous plants are caused by an organism, commonly present in the soil, which infects the younger roots and results in the formation of excrescenses or tubercles.

In the earlier researches on the structure of the tubercle and their contained organism it was assumed that the associated fungus was the cause of the tubercle. But the first demonstrable proof of the relation of soil organisms to the development of tubercles was due almost simultaneously to Hellriegel[84] and to Ward,[85] in 1886.

Hellriegel grew peas in sterilized sand free from nitrogen, but to which the other mineral fertilizers had been added. The plants grew until the stock of nitrogen in the seed was exhausted, when they showed signs of starvation. To these starving plants were added infusions of soil in which peas had previously been grown; in one case this infusion was sterilized, and in the other not. When unsterilized soil infusion was used, the plants began to revive their vigor, and continued to grow to maturity. On their roots numerous tubercles developed.

In the case of the plants watered with sterilized soil infusion, the plants did not revive, and no tubercles formed.

From this experiment and others of like character it was shown that something, probably a living organism, existed in the soil infusion, which was capable of infecting the roots and causing the formation of tubercles; and that by heat this organism could be destroyed.

The experiment also showed that the renewal of vigor of the plant in a nitrogen free soil was corelated with the infection of the roots and the formation of tubercles; in other words, tubercle formation and nitrogen assimilation by the plant were interdependent.

From this point the question of tubercle formation passed from one of mere botanical interest to one of great agricultural importance.

Ward[85] went even further, and besides showing that tubercles could be produced at will by the inoculation of roots with soil infusions, succeeded in tracing the development of the fungus filaments into the root hairs, and thence into the cortex of the root, where he noted the development of the tubercles at these points of infection.

In 1888,[86] Beyerinck, succeeded in cultivating the root tubercle organism on artificial media, and described a number of races from different plants, which he considers varieties of one species of bacteria and which he names *Bacillus radicicola.*

In 1890, Prazmowski,[78] by cultivating the organism of the root tubercles of beans ,succeeded in inoculating their roots with pure cultures of the latter by watering sterilized soils in which the plants were grown, with liquid cultures of the organism.

In 1891, Laurent,[81] by growing legumens in water culture, succeeded in inoculating their roots and producing tubercles at the points of inoculation by puncturing them with a needle whose point was contaminated with root tubercle germs. And a little later, Atkinson[82] succeeded, by growing vetch in water culture, in inoculating their roots and producing tubercles from pure cultures of the organism.

There is thus no doubt but that tubercles on the roots of leguminous plants are produced by infection from without, and by an organism entering the root from the soil.

The organism as it exists in the soil is probably in the form of bacteria-like bodies, and most soils contain them in greater or less abundance. Their method of infecting the root is best described and figured by Atkinson.[82]

The bacterial body has the power to penetrate a root hair and is first seen therein as a filament, extending its entire length, as shown in Fig. 7 B-C, and thence entering the cells of the cortex of the root, causes their proliferation and the production of a swelling upon the side of the root, Fig. 7 A, which by further growth becomes a tubercle. Within the central cells of this tubercle the filaments can be seen branching in all directions as seen in Fig. 8 A.

At numerous points are seen irregular swellings, Fig. 8 A-B,

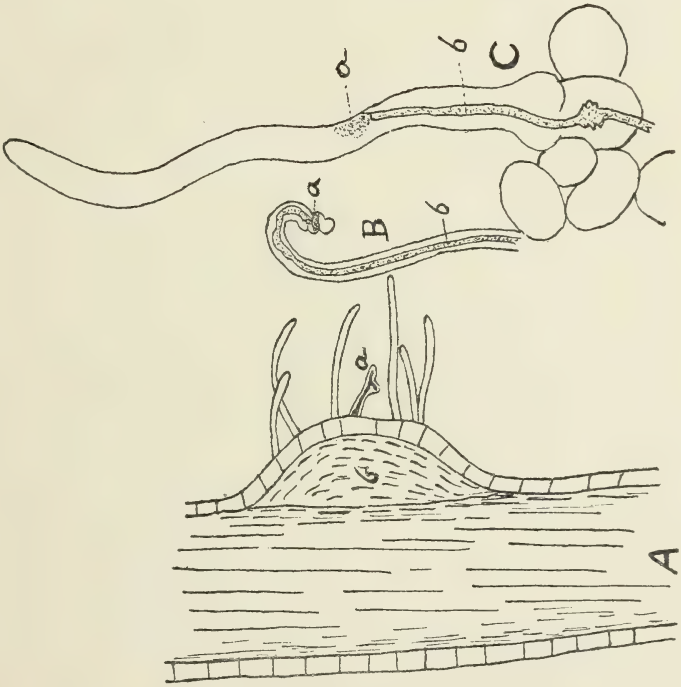

Fig. 7.—Root tubercle formation. Infection of root through root hairs. A, a, infected root hair; b, beginning of a tubercle; B, a, point of entrance of infecting filament into root hair; b, infecting filament; Ca-Cb, as before. (After Atkinson.)

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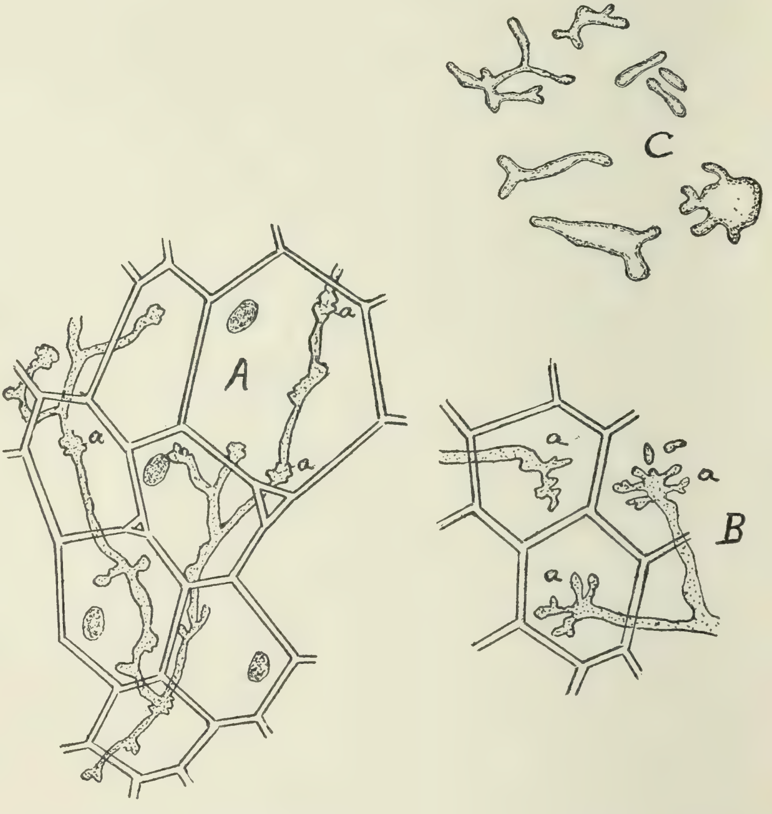

FIG. 8.—Root tubercle formation. A, ramification of filaments within central cells of tubercle; a a, enlargements of the latter from which buds originate. B—aa, showing budding of filaments and production of bacteroids. C, bacilliary and bacteroid bodies. (After Laurent.)

which later on produce buds which become bacterial and bacillary bodies, and which eventually fill the cells of the central portion of the tubercle.

Such in brief is an outline of the biology of the root tubercle organism. For a further exposition of the subject the reader should consult the excellent paper of Atkinson.

2. THE RELATION OF ROOT TUBERCLES TO NITROGEN ASSIMILATION.

It has long been known that clovers enrich land, but the full philosophy of the matter has not been fully understood until comparatively recent date.

Lachmann,[86] in 1858, was probably the first to suspect that certain nodular bodies seen upon the roots of legumes were in some way connected with the absorption of nitrogen by the plant, but no experimental proof of this assumption was given.

In 1864, Rautenberg and Kuehn[87] gave the first inkling of this in their work on water cultures. They noticed that with certain legumens grown in water, nodules formed on the roots of only those plants which were growing in a solution free from some compound of nitrogen. The presence of nodules, therefore, seemed to be associated with an effort on the part of the plant to obtain nitrogenous food.

DeVries,[88] a little earlier, observed that comparatively few nodules developed on plants to which an abundance of nitric nitrogen was supplied. Root tubercle development, therefore, seemed to be associated with nitrogen hunger. But an exact demonstration of the relation of root tubercles to nitrogen assimilation by the plant was not made until 1886, when Hellriegel announced his important series of researches.

Hellriegel[84] was able to grow peas and other legumens in pure sand absolutely devoid of nitrogen, but supplied with other plant food. The sand was sterilized so as to destroy all germ life therein. Peas etc., grew in such a soil only under certain conditions, i. e., when the soil was infected with an infusion containing the living germs of root tubercles. Soils inoculated with sterilized infusions, or soils not inoculated and previously sterile, failed to grow peas.

In the infected soils the peas developed tubercles, and with their development the plants thrived and attained their full maturity. Since the soil was devoid of nitrogen, the plants could have gained the nitrogen for their fruition from but one source, and that was the atmosphere.

Hellriegel thus, as a result of an elaborate series of experiments, was able to announce positively that leguminous plants were able to utilize the free nitrogen of the air.

But an announcement so radical and startling as this could not rest on the authority of one man alone, and accordingly, Hellriegel's experiments, with modifications, were repeated by numerous investigators, notably, Nobbe, Hiltner and Schmid,[89] with the same results.

In Hellriegel's experiments his plants were grown in the open air, and since atmospheric air contains combined nitrogen in the form of ammonia and nitrous acid, it was a question, though the soil might be free from nitrogen, whether the nitrogen compounds present in the air might not be the source of nitrogen to the plant instead of free nitrogen.

Accordingly, in 1892, Atwater and Woods,[90] in this country, grew peas in glass cases the air of which was free from every trace of combined nitrogen. The soil and nutrient solution used to water and fertilize the plants were also nitrogen free. At the end of the experiment, covering 85 days, 27 plants had made an average growth of 29 inches, with a total gain of 242 mg. of nitrogen. It was furthermore noted, that as a rule the largest gains were in those plants which showed the largest tubercle development. Thus, the authors conclude, "The free nitrogen of the air was alone available to the plants, and the gain must have been by the acquisition of free nitrogen."

There is, therefore, no longer any doubt remaining in the minds of scientists that leguminous plants possess the power of utilizing the free nitrogen of the atmosphere.

It has also been shown that they do this in proportion to the poverty of the soil in available nitrogen. In other words, the plant does not utilize the function of appropriating free nitrogen unless forced to do so.

A legumen will thrive in the presence of an abundance of available nitrogen in the soil, or will respond to a liberal application of nitrate of soda. And it does so because it is easier for it to utilize a form of nitrogenous plant food already prepared for it than to go through the more elaborate process of appropriating the free nitrogen of the air.

But if the soil be deficient in nitrogenous food the legumens will extend their appropriating energies along these new lines, eventually overcome their soil environment and come off the victor.

On this principle is based the value of leguminous plants as soil enrichers.

It has been stated, and has perhaps been fairly well established, that the increase in nitrogen in legumes is proportionate to the development of tubercles.

In his experiment with beans, Halsted[91] found that in every case there was a decided increase in yield of beans on soils where several successive crops of beans had been grown, over the yield where grown on a soil for the first time. The roots of the plants growing upon old ground were well supplied with tubercles, while in the new soil they were usually almost entirely absent.

Lane,[92] in New Jersey, obtained similar results with the cowpea, when grown for three successive crops on the same land. The first season but few tubercles were noted, and the yield was 6.56 tons per acre. The second year the tubercles were more abundant and the yield was 7.19 tons per acre. The third season the tubercles grew abundantly and the yield per acre was 10.02 tons.

The fertilizer applied the third season was less than one-half that applied the second and it is believed that the increase was due in a large measure to a greater abundance of tubercles.

It is a general observation that both annual and perennial legumens grow better a second season than they do the first, and this is probably due to a larger seeding of the soil with the organisms necessary to the production of tubercles on the roots.

It is claimed by Nobbe and others that root tubercles exert no influence in nitrogen assimilation when there is an abundance of available nitrogen in the soil. The tubercles being held to be the organs for such assimilation, this amounts only to saying that these organs will not perform this function unless called upon to do so, but let this necessity be forced upon the plant, the function of the tubercles is exercised, and the greater their number the greater will be the gain of the plant in nitrogen.

Furthermore, the poorer the soil in available nitrogen, as shown by Hiltner[93] in the case of *Alnus glutinosa*, the greater is the number of root tubercles which will develop, provided the necessary organisms are present in the soil. Hence under conditions of nitrogen starvation or deficiency the number of tubercles on the roots becomes a measure of the nitrogen assimilating activities of the plant.

3. Do Other Plants Than Legumes Assimilate Free Nitrogen?

The power of legumes to assimilate free nitrogen does not rest on the fact that they belong to a certain family of plants, the Leguminosae, but rather to the fact that their roots contain tubercles. This is instanced by the common alder whose roots bear tubercles. Hiltner has shown that young alders without root tubercles, and deprived of combined nitrogen, are unable to assimilate atmospheric nitrogen, and that the plants are poorly developed. But when by inoculation, tubercles are produced, the plant can utilize free nitrogen as in the case of legumes. This is well illustrated in Fig. 9.

The alder is therefore the one non-leguminous plant which is able to assimilate atmospheric nitrogen.

Regarding other non-leguminous plants, the question of nitrogen assimilation has been raised, but the answer has, on the best authority, been in the negative. Thus Lotsy[94] showed the inability of white mustard to utilize free nitrogen and the same was shown by Nobbe and Hiltner[95] regarding mustard and buckwheat.

So far as present knowledge goes we may, therefore, assume that plants without tubercles are unable to utilize free atmospheric nitrogen.

4. Are There Different Species of Root Tubercle Organisms.

This is a question which has frequently been raised, but which as yet cannot be positively answered.

Nobbe held that there is a separate race of bacteria for each species or group of nearly allied species of plants. On the other hand Mazé, an equally good authority, claims that there are certain physiological forms of bacteria determined by the nature of the media in which they are developed. These are able to inoculate the roots of plants growing in soils offering the proper conditions for their development.

Beyerinck[36] has made a careful study of the different forms of bacteroids found in different species of legumens, and records differences among them. Voelcker[97] illustrates 16 different forms of bacteroids from different species of legumens, but states that on cultivating these organisms on nutrient media their differences disappear and that they can no longer be distinguished the one from the other.

This would indicate that differences in the form of the organism, as seen within the plant, has little significance, and is controlled perhaps entirely by the differences in the host. For it is a well known fact that one and the same bacterial organism will often present variations in form when grown in media of different character.

It is thus evident that the question of differences of species cannot be settled from the standpoint of differences of form, but must be determined from the physiological side.

Nobbe, Hiltner and Schmid[98] have thrown important light on the question in their inoculations of different legumens with pure cultures.

Their experiments show that the organism from a single species of legumes is capable to a greater or less degree of infecting and of producing tubercles on the roots of a number of distinct species. Thus the vetch can be infected by means of culture from Robinia (locust) Acacia, Vicia (vetch), and Pisum (pea); but the greatest de-

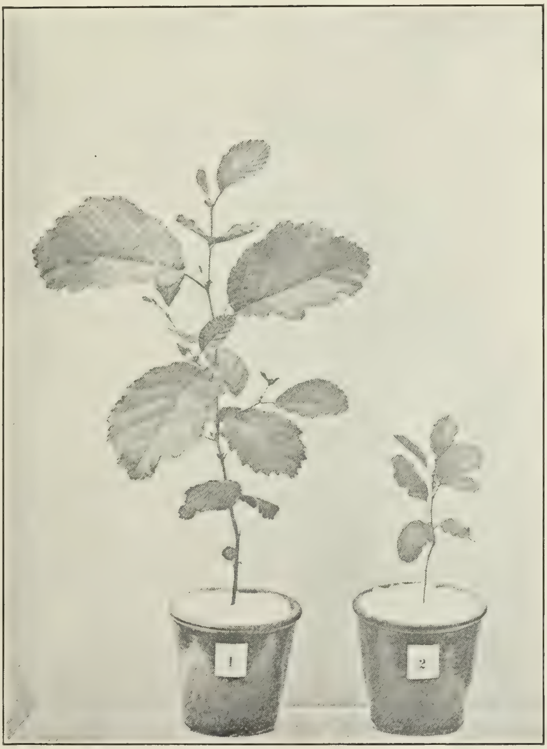

FIG. 9.—Alnus in sterilized soils. Pot 1, inoculated with bacteria from Alnus tubercles. Pot 2, soil not inoculated. (After Hiltner.)

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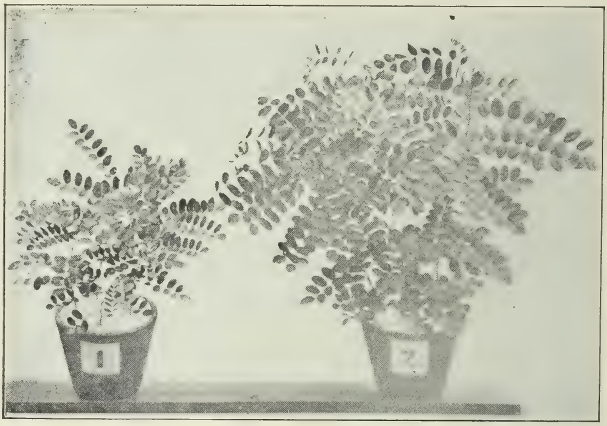

FIG 10.—Robinia pseudacacia in nitrogen free soils. Pot 1, inoculated with bacteria from pea tubercles. Pot 2, inoculated with bacteria from Robinia tubercles. (After Nobbe, Hiltner and Schmid.)

velopment of the vetch took place when its roots were inoculated with vetch organisms. In other words, a given legumen is most susceptible to organisms of its own kind, and but feebly so to those of another species. (See Fig. 10.)

In the following table are given the results of these inoculations by the above authors:

Chemical Analysis of Plants.

	Inoculated With Pure Cultures From			
	Robinia.	Acacia.	Vicia.	Pisum.
Robinia dry substance—grams,	7.402	1.158	0.858	1.479
Robinia nitrogen—milligrams,	232.100	16.600	13.500	21.100
Acacia dry substance—grams,	1.953	6.943	1.248	1.817
Acacia nitrogen—milligrams,	17.000	109.800	16.200	19.700
Vicia dry substance—grams,	0.783	0.866	9.133	1.033
Vicia nitrogen—milligrams,	12.900	14.700	264.000	22.600

The differences here noted can only be explained by a consideration of the question of virulence of the organism, and of specific adaptation.

The pea tubercle organism by its growth in the pea root becomes especially adapted to that host, and losses its adaptability to another host. This, however, is a property more or less elastic, and subject to artificial modification.

Thus Nobbe and Hiltner [99] have shown that when peas were inoculated with cultures from bean tubercles, some tubercles would be formed but the organism seemed to be without the power of assimilating nitrogen; but if the same inoculation was continued upon a second generation of plants, the bacteria became nearly as efficient as those from the roots of the same genus. In other words, by passing pea tubercle bacteria successively through beans, the virulence at first feeble was decidedly increased.

The same authors have also shown that different cultures possess different powers in producing tubercles. Thus if a plant already possessing tubercles is inoculated with a culture of the same virulence there is no increase in the number of tubercles, but when inoculated with a culture of a higher virulence there is an increase in the number and size. The authors, therefore, hold that a plant may acquire a certain immunity against infection by bacteria of a certain degree of virulence.

This may account for the failure of land in many instances to grow clover, so called "Clover sickness," when there is reason to believe that the soil is well supplied with the specific organisms.

To return to the question of species among different root tubercle organisms, it may be concluded that distinct species do not exist, and that there is but one species of variable virulence, capable of infecting the roots of any of the legumens either feebly or readily. That this species, which may at first attack a given host but feebly, has its virulence so increased by repeated growth in that host that it eventually is able to produce ready infection.

5. Relation of the Soil to Tubercle Production.

It has been stated that legumes will grow readily in soils where there is an abundance of available nitrogenous food independent of their power to assimilate atmospheric nitrogen. The legumes, however, are so rich in nitrogen, and such vigorous growers as a rule, that their demands for nitrogen are greater than those of any other class of agricultural plants. Hence, in ordinary soils, legumes must utilize their nitrogen assimilating function to a greater or less degree.

In poor soils, and these are the ones in which we desire to grow legumes as soil enrichers, there is often at first a struggle on the part of the legumes for existence, particularly is this true when a new legume is introduced.

It is assumed that in most soils root tubercle organisms of one variety or another exist, but often in such few numbers or in such an attenuated form as to feebly affect the plant. In this event an introductory crop of that legume, however small, may be necessary for the purpose of stocking the soil not only with the necessary number of organisms but with those of the proper degree of virulence. Soils, therefore, become adapted to the growth of any legume and this adaptation consists in an abundant supply of organisms of the proper virulence to infect the roots.

Nothing directly is known regarding the relation of soil acidity to the life of root tubercle bacteria therein, but Salfeld found that the addition of lime to land was beneficial to the development of root tubercles on field peas, lentils and garden peas.

6. INOCULATIONS OF SOILS.

As soon as it was shown that root tubercle development was dependent upon the presence in the soil of specific organisms, the question of seeding the soil with such organisms was raised. The experiments which have been conducted on seeding land with soil in which the specific organisms of any leguminous tubercles are known to exist, have sometimes given positive and at others only indifferent results.

The positive results have usually come from the inoculation of virgin soils, moorlands or barren soils that have not previously born leguminous crops.

Salfeld,[100] in North Germany, obtained excellent results on the large scale on recently reclaimed moorlands sown to peas and beans which had received applications of lime, phosphatic slag, kainit and nitrate of soda, together with small quantities of fertile loam from fields that had previously born good crops of these plants.

In this case it was probable that the soil was deficient in nodule producing bacteria. Freewith[101] found that in plots containing lupines, and inoculated with lupine soil at a rate of 1,600 to 3,200 pounds of earth per acre, there was an increase in yield of stems, leaves and hulls of from 67 to 72 per cent. In plots containing serradella, and inoculated with serradella soil, at the rate of 80 pounds to the acre, there was an increase of yield of fodder of from 41 to 282 per cent.

In the latter case tubercles were found on the roots of the plants grown in inoculated soil, while they were absent in those grown on uninoculated land. In this case there must have been an absence or deficiency of the proper organisms present, which were supplied by the soil inoculations.

Soils which have been previously uncultivated are more likely to respond to soil inoculation than those which have been under tillage. Thus Schniftes[102] found that when cultivated clay soil was inoculated with earth containing bacteria from the root tubercles of lupines no favorable results were obtained. But when soil previously uncultivated was inoculated in the same way the increase of yield was from 11 to 32 per cent.

Otis,[103] of Kansas states that soy beans have been grown for eight years at the Kansas Station, but during that time tubercles were not found on their roots. Accordingly he secured soil from Massachusetts in which tubercle bearing soy beans had been grown. This soil was used to inoculate the Kansas soy beans. All the inoculated plants showed tubercles; there was also, as compared with uninoculated plants, a greater diameter of the lower part of the stem. Analyses of the crop showed also a slight increase in nitrogen, protein and water content.

Instead of soils, use has recently been made of cultures of the bacteria found in the root tubercles. Such cultures have already become a commercial product under the name of *Nitragin.*

The organisms are grown upon a specially prepared gelatin medium. Cultures from different legumes are made and sold, so that the proper organisms can be supplied for any given leguminous plant.

In using the cultures, the tubes containing them are placed in luke-warm water having a temperature of about 90 degrees F., to melt the gelatin and disseminate the germs throughout the medium. This is then mixed with a small quantity of water, and in this the seed is immersed previous to sowing, or the diluted cultures can be mixed thoroughly with earth and the latter sown broadcast over the land, immediately after the seed is sown. In immersing the seed in the solution the germs are brought into immediate contact with the developing plant, when root infection is more apt to follow.

The experiments on the use of nitragin have been so extensive and varied that it will be unprofitable to detail them here. Furthermore, the results have been so contradictory that confusion is likely to overwhelm the reader were we to review them.

In many cases increased yields have followed the use of nitragin, in others no benefit has resulted. Perhaps the failure in many cases has been due to the use of inactive nitragin, but, in most instances, it was likely owing to the fact that the necessary organisms were already abundantly present in the soil.

The question of the inoculation of soils, either with soils or with nitragin, therefore, resolves itself into one of whether the necessary organisms are already present.

In the cases where beneficial results have been attained, the soils on which it was used was either barren or otherwise below the standard of what might be classed as fertile soils. In the case of poor, sandy or worn-out lands, nitragin will doubtless be useful in initiating a good growth of any particular legume, until by a first crop the soil shall become well supplied with the necessary bacteria; after that there would be no advantage in its further use. In ordinary arable land some form of the tubercle organism is probably present in proper numbers to infect the roots to a degree sufficient at least to stock the soil with organisms of the proper virulence for another season.

Cases where nitragin is advisable are, therefore, the exceptions rather than the rule, and on this point no hard and fast lines can be drawn. The indiscriminate use of nitragin has led to many failures and disappointments. Like all good things when wisely used it is useful, but when used without judgment it is liable to meet with unjust condemnation.

7. INCREASE OF THE NITROGEN CONTENT OF SOILS.

It is a familiar fact that land left to itself in an undisturbed condition increases in fertility from year to year. In the forests and prairies of our own country we have profited by the accumulated fertility of centuries, and much of our present National wealth we owe to those biological processes of the soil we are about to enumerate. By these we mean the ability of the soil to accumulate nitrogen through the agency of microscopic organisms, and the lower classes of plants. Every observer is familiar with the growth of lichens on bare rocks on which no organic food, much less nitrogen in any appreciable quantity, is present; and yet such plants contain nitrogen and contribute it to the thin mantle of soil which slowly accumulates over rocky surfaces.

Fungi are frequently found on sterile sand in which only an inappreciable quantity of nitrogen is present, and yet they may store up in their tissues quantities of nitrogen greatly in excess of what the soil is able to furnish.

Mulder showed that moulds grown upon non-nitrogenous substances always contain protein, and his experiments are quoted by Storer.

In aqueous solutions of sugar left "for three months in stoppered bottles, with a seven fold volume of air, an abundance of mould grew, which, on being collected and subjected to dry distillation gave off large quantities of ammonia. So, too, starch kept under water in a bottle that contained air soon fermented, and the fungus which it had nourished gave off ammonia on being distilled."

It is now generally recognized that fungi, microscopic algae, and perhaps other of the lower cryptogams, possess greater or less power of fixing atmospheric nitrogen.

Bertholet[104] held, and, in fact demonstrated, that certain microscopic organisms of the soil do appropriate the free nitrogen of the air. During the growing season, in clayey and sandy soils, he observed a slow but continual fixation of nitrogen from the air. This increase, furthermore, failed to take place when the soils were sterilized by heating them to 230 degrees F. From this it was concluded that the fixation of nitrogen was due to certain micro-organisms which were destroyed by the heat. Bertholet, from his laboratory experiments, calculated that as much as 75 to 100 pounds of nitrogen per acre could be fixed in this way, and in two exceptional cases as high as 525 and 980 pounds to the acre.

A number of chemists, notably, Koenig, Kiesow, Armsby, Birner, Kellner, Dehérain and Avery[104] found that when organic matter in one form or another undergoes fermentative changes of a putrefactive character, there was frequently an increase of nitrogen in the fermenting substance. This was particularly marked when the materials were kept alkaline with carbonate of soda or lime.

The explanation given for this increase was that a combination of nascent hydrogen evolved during the fermentation took place with the free nitrogen of the air by which ammonia ($N H_3$) was produced.

It is known that hydrogen is a common product of putrefactive fermentation, and it is highly probable that when such putrefactive changes take place in the soil there is a certain fixation of atmospheric nitrogen.

The claim of Bertholet that micro-organisms of the soil possess the power of utilizing free nitrogen led Winogradsky[105] to test the validity of this assertion. Of 15 separate species of soil bacteria isolated by him only one of them was able to assimilate nitrogen to any appreciable degree. To this he gave the name *Clostridium pasteurianum.*

Cultures of the latter were made in saccharine media free from combined nitrogen, in which the organism grew, apparently dependent upon the free nitrogen of the atmosphere for their food. The conclusion which the author reaches, however, is that the power of fixing nitrogen is not general among micro-organisms.

Since Winogradsky's investigations of the above, a few others have been isolated which are capable of fixing free nitrogen, notably, *Bacillus ellenbachiensis*, which is now sold in the form of cultures known as *a linit.*

The fact that but few species of bacteria possessing the power of utilizing free nitrogen have been found is no argument that they do not exist in the soil, and the fact that soils do make appreciable gains in nitrogen is indication that the necessary organisms must be present.

From a practical standpoint the matter has little significance, since the gains of soils from this source are in a single year inconsiderable as compared with those which can be so readily brought about by the growth of legumes.

To effect results of momentous importance their action must cover long periods of years such as have passed before the advent of European agriculture on the American continent.

8. The Use of Alinit.

All great discoveries are likely to lead to spasmodic efforts to revolutionize agriculture, and the climax has been reached in the effort to seed on soils with nitrogen assimilating bacteria by the use of alinit.

Alinit is a culture of *Bacillus ellenbachiensis*, which organism is claimed to possess the power of utilizing atmospheric nitrogen. It is supposed to be particularly valuable in the growth of the cereals which lack the power of utilizing free nitrogen.

In the use of alinit, both beneficial and indifferent results have been obtained, but the experience in its use have not been as yet extensive enough to warrant definite conclusions being drawn regarding its value; but from a theoretical standpoint there is little to recommend it.

B. ellenbachiensis is probably identical with *B. megatherium* which is commonly present in soils, in which case nothing new is added to the soil by its use. Furthermore, of the myriads of bacteria present in a handful of soil, the addition of a relatively infinitesimal quantity of alinit would be like a drop of water added to a reservoir, and in the struggle for life between these myriads of soil bacteria there is a question whether one *B. ellenbachiensis* in a million other forms would be certain of a maintained existence, or at any rate be liable to multiply to a degree in excess of the others, sufficient to produce appreciable results.

If soil bacteria in general, as is probably the case, have any important relation to nitrogen assimilation, more is to be gained in following those methods already set forth, which aim to provide for the best development of soil bacteria in general.

At best, the gain of nitrogen from the use of artificial cultures, or from the stimulation of the development of any nitrogen assimilating bacteria already present, will be far below the demands of agricultural plants, and also inferior to the means which we have in the utilization of leguminous plants in our systems of rotation.

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COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 99.

SOME COMMON INSECT PESTS OF THE FARMER.

BY

H. T. FERNALD, Ph. D.

PUBLISHED BY DIRECTION OF THE SECRETARY.

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PREFACE.

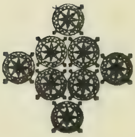
Harrisburg, Pa., August 1, 1902.

The following bulletin No. 99, entitled "Some Common Insect Pests of the Farmer," has been prepared by Dr. H. T. Fernald, formerly Economic Zoologist in this Department.

The prevalence and destructive character of insect pests has compelled farmers and gardeners to study their habits and the means for their destruction or control. This bulletin treats of a number of varieties of insects that are most troublesome, and gives specific instructions for dealing with them.

Most of the methods suggested are quite simple, and can be employed by any careful person, who has had some experience in dealing with the fumigation of plants, the application of insecticides and the use of spraying mixtures.

JOHN HAMILTON,
Secretary of Agriculture.



LETTER OF TRANSMITTAL.

Hatch Experiment Station,
Amherst, Mass., July 10, 1902.

Hon. John Hamilton, *Secretary of Agriculture, Harrisburg, Pa.:*

Dear Sir: In accordance with your request, I submit herewith the copy for a bulletin on various insects which are causing much injury and loss to farmers and fruit-growers in Pennsylvania. Most of the insects herein treated have been written about before in previous publications of the Department, but recent and more thorough study has, in nearly every case, thrown more and better light upon the problem of their treatment, and these advances in our knowledge have been incorporated in this bulletin.

Yours respectfully,
H. T. FERNALD,
Professor of Entomology, Massachusetts Agricultural College.

SOME COMMON INSECT PESTS OF THE FARMER.

BY H. T. FERNALD, PH.D., *Department of Entomology, Massachusetts Agricultural College, Amherst, Massachusetts.*

The loss to crops caused by the attacks of insect pests is rarely appreciated. A quarter of a century ago even those who studied the subject considered this loss as being about one-tenth of the total crop. To-day this is recognized as being too low and estimates of fifteen, twenty and even twenty-five per cent. are often met with. Whether the earlier estimates were too low, seems doubtful, it being more probable that the actual amount of loss has increased with the increase of continuous acreage taken by man; by the introduction of over seventy-five of the worst pests of foreign countries; and by the decrease in number of our insectivorous birds. To-day every acre tilled, every fruit tree, every vine and every stalk of grass contributes of its substance for the sustenance of insects, and it is probable that before many years pass, every crop must be so treated as to prevent loss by their ravages, if any profit whatever is to be obtained.

Some of the most frequent and seriously injurious insects with which farmers in Pennsylvania meet are considered in this paper, and, in order to combat these insects intelligently, a knowledge of their lives is necessary; hence a brief outline of the life history is given in each case, in addition to the methods of treatment most generally found to be successful.

THE HESSIAN FLY.

(Cecidomyia destructor Say.)

The Hessian Fly is an insect which causes great loss to the wheat crop in Pennsylvania as well as in all the wheat raising States. This loss varies in amount from year to year; but is always considerable and may be as much as three-quarters of the entire crop.

Life History.

There are two broods of this insect each year. The adult flies usually appear in August and September and lay their eggs on the leaves of the little wheat plants, placing from one to twenty-five or thirty eggs on a leaf and laying from one hundred to one hundred and fifty eggs in all (Fig. 1, F.). The eggs are very small, reddish, oval in outline (Fig. 1, C.), and usually hatch in four or five days, producing tiny white maggots which crawl down the leaf to the stem, then down between the stem and leaf sheath to the joint near the level of the ground. Here they remain, sucking the sap until cold weather comes, by which time they will have become about an eighth of an inch long (Fig. 1, D.). They then turn brown and become the well-known "flax seeds" so common in wheat fields during the winter. In this condition (Fig. 1, E.) they remain till spring when changes inside the **"flax seed"** produce the fly which escapes to lay eggs for the second or spring brood.

The eggs of this brood are laid as before on the leaves of the wheat but usually higher than those laid in the fall, so that the maggots which hatch from these eggs lie above the ground level, just above the lower joints. Here they remain feeding for about a month, then enter the "flax seed" stage, from which the adult flies appear in August and September to lay their eggs on the young wheat plants which have newly come up.

The adult fly is about the size of a mosquito, with dusky wings (Fig. 1, A, B. F.).

Food Plants:

The favorite food plant of the Hessian Fly is wheat, though it also attacks rye and barley. In some cases it has been reported as working in hay fields, but this is probably incorrect. Winter wheat on which the maggots are feeding has much darker colored leaves than plants unaffected, and tends to stool out freely causing the plants at first to appear particularly healthy. Later, however, the plants turn yellowish and die either in part or entirely. Injury to plants in the spring is chiefly shown by a weakening of the stems and an at least partial failure of the grain on the affected stalks to fill out. The laterals—tillers—which escaped the attacks of the fall brood are usually the ones injured by the spring brood.

Enemies.

There are several insects which prey upon the Hessian Fly. Unfortunately, they cannot be relied upon to protect the wheat, but only to somewhat reduce the loss, and methods for checking the work of the fly are also necessary.

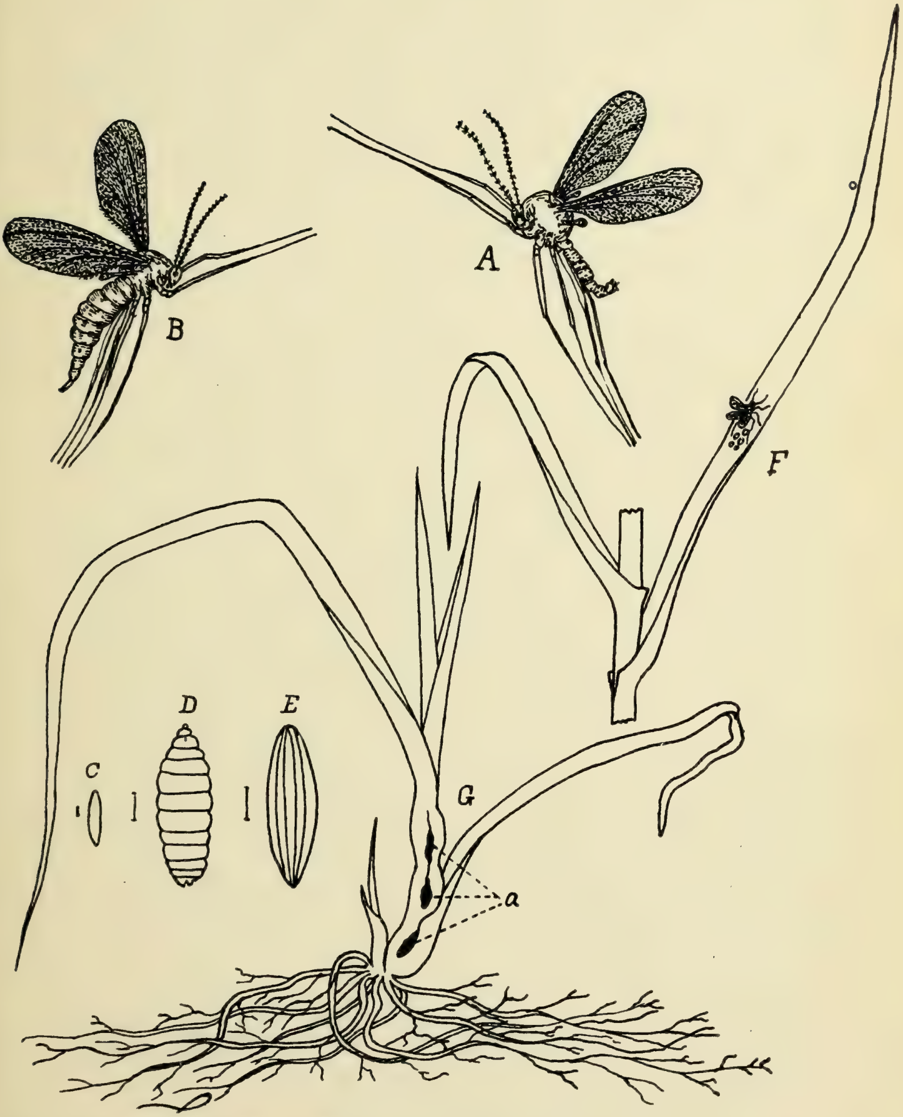


Fig. 1.—The Hessian Fly.—A, Male Hessian Fly, much enlarged; B, Female, also much enlarged; C, eggs; D, maggot; E, Flaxseed stage; F, piece of stalk showing fly natural size, laying eggs; G, stalk of wheat injured at *a*, by the fly. The fine lines beside C. D. and E. show the true length of these stages, the drawings being enlarged.—(Modified from *Riley.*)

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Treatment.

There are several ways in which the injuries caused by the Hessian Fly may be reduced, though no one of these is of itself sufficient to give entire protection.

Late fall planting is generally a method of control which is quite successful. The flies appear during the latter part of August and first of September and by the last of the latter month have died. If the wheat be planted as late as the twentieth of September, therefore, the flies will be gone before it has come up and no eggs will be laid upon it in most cases. Unfortunately, however, this date is not a fixed one for different latitudes and elevations. In southeastern Pennsylvania it might be necessary to delay planting for a week or more after this date, while in the higher lands of the northern parts of the State sowing could perhaps begin as early as the tenth of the month with success.

The fear that wheat sown as late as the twentieth of September will suffer the following winter is practically groundless, as a large amount of growth is unnecessary, for the above ground portions are mostly destroyed in any case.

One factor bearing on the date at which wheat should be sown to escape the attacks of the fly, is that of the weather conditions. A hot, dry August seems to delay the fall brood of this insect, which accordingly appears later than usual and is able to attack the late sown wheat. This was noticeably the case in Pennsylvania in the fall of 1900, and in some cases at least, threw discredit on the plan of late planting.

If sowing after the twentieth of September be practiced, it is quite important to have co-operation with all wheat-growing neighbors. If ten or a dozen wheat-growers should agree to plant late, and one should refuse, the fly will find abundant opportunity to lay its eggs on the wheat of the latter and thus produce a supply of insects which will, the following spring, spread to the surrounding wheat fields and lay their eggs for the spring brood, thus rendering late planting the previous fall a failure, at least in part.

A trap strip of wheat planted early in August is an excellent, but too seldom used, method for controlling this insect in connection with late planting. Such a small strip sown along one side of the field which is to be planted later will be available for the flies to lay their eggs on, and after egg laying has been accomplished the flies very soon die, or if they should live would of course no longer be dangerous to the main crop. This trap strip should be plowed under before the wheat in the field comes up, thus destroying multitudes of the young.

Burning the stubble soon after reaping is a valuable treatment, as the spring brood of the fly develops at the lower joints of the wheat and a great many "flax seeds" of this brood will be left in the field at harvesting time. Turning the stubble under is also of value where burning it would be difficult, provided the ground be then rolled so that the flies which come from the "flax seeds" will be unable to reach the top of the ground. Some varieties of wheat are more resistant to the attacks of the fly, than others. Among these are the Clawson, Mediterranean, Red Cap, Underhill, Dawson's Golden Chaff and Prosperity.

The destruction of volunteer wheat is important, as many flies pass the summer in such plants.

THE WHEAT-STEM MAGGOT OR WHEAT BULB-WORM.

(Meromyza americana Fitch.)

The wheat-stem maggot has long been known as an enemy to wheat in Pennsylvania, but its habits and injuries so nearly resemble those of the Hessian Fly, that its work is usually supposed to be that of the latter insect by those not familiar with it.

Life History.

This insect attacks wheat, barley, oats and various grasses. The adult fly deposits its eggs on the wheat in September and October and the maggots which soon hatch crawl down to some joint near the bulb and feed upon the stalk, cutting it off. They pass the winter in the stem, become quite pupæ in April or May and the adults emerge from these pupæ early in June. These adults usually deposit eggs on the sheath of the upper leaf and the maggots which hatch from them feed on the stem near the upper joint, causing it to wither, and the heads to turn white. The adults produced from these maggots appear in July and early August and their young attack timothy, blue grass ,volunteer wheat, etc., and mature in time to produce adults which deposit their eggs in September and October, as already stated, on the young winter wheat. There are, therefore, three broods each year.

Treatment.

Little that is successful has yet been discovered in the way of treatment for this insect. Late planting is useless as the insects may lay their eggs as late as the middle of October. The summer brood is probably the best place in the life of this insect at which to attack

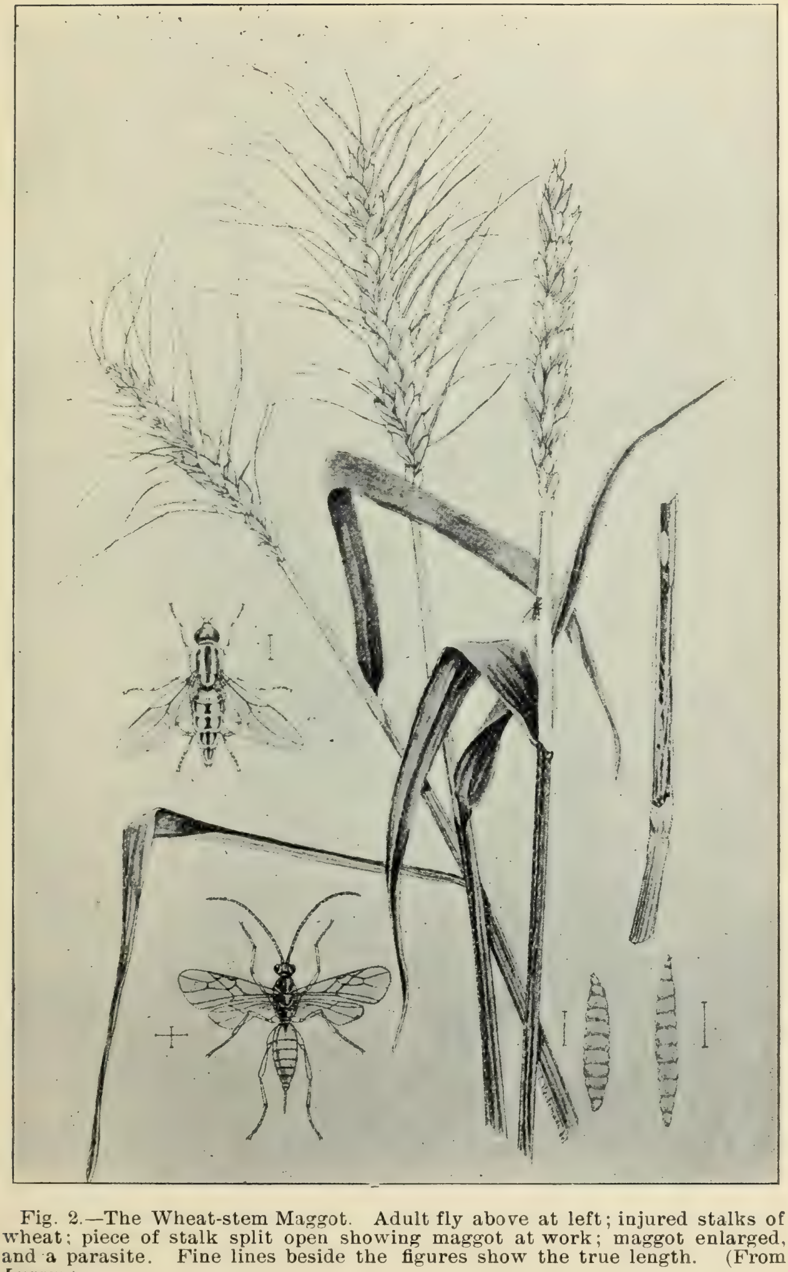

Fig. 2.—The Wheat-stem Maggot. Adult fly above at left; injured stalks of wheat; piece of stalk split open showing maggot at work; maggot enlarged, and a parasite. Fine lines beside the figures show the true length. (From *Lugger.*)

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it. This brood feeds on volunteer grain and grasses and if a trap strip of wheat were planted about the fifth of July it would provide a place for the insects to lay their eggs. This trap strip should be plowed under about the middle of August thus destroying all the insects which were in it. Whether this treatment will pay, however, can only be determined in each case by the amount of loss caused by this insect.

Fortunately, the wheat-stem maggot is not without enemies which attack it in such numbers as to prevent its injuries being far more serious than is usually the case.

THE ARMY WORM.

(Leucania unipuncta Haw.)

This well known pest preferably feeds upon grasses, and wheat, oats and corn are therefore favorite articles of food. As it is not limited to these food plants, however, it frequently is seriously destructive to clover, peas, apples, cucumbers, barley, rye, etc. With such a range of plants to feed upon, it is fortunate that this insect is not often seriously abundant for more than a year or two at a time.

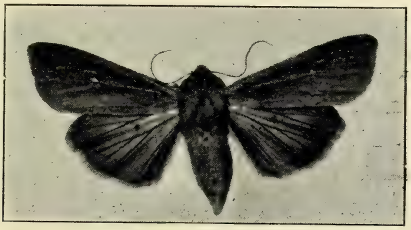

Fig. 3.—The Army Worm Moth, natural size.

Life History.

The eggs of the Army worm are laid in the spring and the caterpillars which hatch from them become adult moths in June. These moths lay their eggs for a second brood and the caterpillars of this brood are often so abundant as to do much damage during the month of July. About the end of this month, however, the caterpillars become full grown, cease feeding, enter the ground to pupate and the moths which emerge from them appear in August and lay eggs for a third brood. The caterpillars of this brood are sometimes so abundant as to cause much injury, but it is more usually the case that those of the second brood are the ones whose ravages are most seriously felt. The caterpillars of the third brood usually reach the moth stage before winter, but those which fail to develop so far, pass the winter in whatever condition they may happen to be and become adult the following spring. It is possible that in southern Pennsylvania a fourth brood may be able to develop, particularly in years when there is a late fall.

Injuries.

The first brood of caterpillars does but a moderate amount of damage, eating holes in the leaves. When the food available has all been eaten, the caterpillars search for more, starting off together and forming the "armies" which have given to this insect its name. This almost never occurs with the first brood, however, and only at intervals of several years with the second or third broods, the insects not being usually so abundant as to exhaust their food supply. Upon reaching food, the caterpillars begin their work and strip everything as they go, and when full grown, either under ground or among leaves and grass, become quite pupæ from which the moths subsequently emerge.

Parasites and Treatment.

The Army worm has a number of parasites which feed upon it and their activity is probably the reason why this insect is not more often a serious pest. Among its most efficient foes are two kinds of flies which occur in large numbers where the Army worm is abundant.

Parasites, however, sometimes fail to destroy enough Army worms to prevent much loss, and in such cases, treatment must be resorted to. Where a field is thoroughly infested by these pests, little can be done, but when the caterpillars begin their march for more food, an excellent practice is to plow a furrow across their line of march, throwing the earth towards the advancing army. In order to cross this furrow each caterpillar must crawl over the loose earth thrown up, then cross the bottom, and finally crawl up the steep side. At intervals of a few feet along the bottom of the furrow, holes may be dug (or bored with a post hole auger if the ground will permit) and many of the caterpillars will collect in these holes, which may with advantage be made as much as two feet deep. A band of gas tar placed along the bottom of the furrow may be used to hold the caterpillars, when it can be obtained, and sometimes straw scattered along in the furrow and set on fire when covered by the caterpillars has proved useful. When the army is large, two furrows a few feet apart may be needed to check its advance.

Sometimes the progress of the caterpillars can be checked by heavily spraying a strip of field at the edge they are approaching, with Paris green. The insects coming to this strip first, feed upon it and are poisoned. Care should be taken, however, in such cases, not to feed any of that part of the crop thus sprayed, to stock.

WIRE WORMS.

(Elater sp.).

The injuries caused by wire worms are frequently quite serious, and as the work of these insects is upon the roots of plants it is difficult to control them. In reality, wire worms are not adult insects, but the young of "Snapping beetles" or "Click beetles" as they are often called, from the habit they have when placed on their backs, of suddenly "snapping" themselves in such a manner as to throw themselves into the air, when they in most cases can fall on their feet.

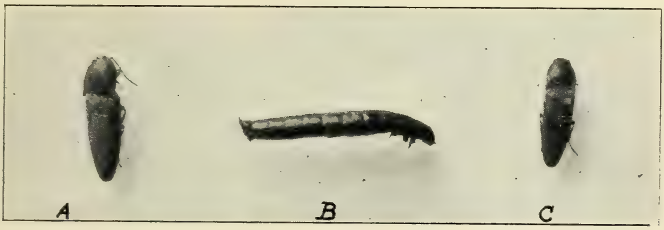

Fig. 4.—Wire Worms. B, side view of a wire worm; A and C, adult of wire worm (click-beetles).

There are many kinds of snapping beetles in the United States and a corresponding number of kinds of wire worms, their young. A few live under the bark of trees or in decaying wood; most, however, live in the ground and feed upon seeds and the roots of various plants, often causing much loss.

Life History.

The eggs of these insects appear to be laid in the spring usually and from them the little wire worms soon hatch and begin to feed. It generally takes several years before the little wire worms have fed enough to become full grown, but when this condition has been reached each forms a little cell in the ground, during the latter part of the summer, and in this cell changes to an adult snapping beetle, which remains in the cell till the following spring.

Treatment.

Treatment for this pest is not usually possible by means of poisons though in some cases their numbers might be reduced by such methods.

Probably the best way in which to control wire worms is by late fall plowing, repeated for two or three years. This destroys the wire worms by bringing them up to the surface of the ground where exposed to the freezing and thawing of the winter, many will perish or be devoured. Breaking the cells above described appears to cause the death of the insects which occupy them, and thus fall plowing is useful for the destruction of this stage as well. Rotation of crops is unfavorable to the increase of wire worms and should also be practiced for this reason if for no other.

THE ANGOUMOIS GRAIN MOTH.

(Sitotroga cerealella Oliv.)

This insect is an important enemy to wheat and corn in Pennsylvania, often causing much loss, particularly when appearing during the fall after the attacks of the Hessian Fly have greatly reduced the amount of wheat produced.

The Angoumois grain moth has been present in this country for many years, being most injurious in the south where the longer seasons permits a greater number of broods than is possible in northern latitudes. In Europe it is also a pest and takes its name from a province of France where it has caused much loss.

Life History.

The moth of this insect is very small, about the size of the clothes moth, and yellowish in color. It appears in the spring, usually during May and June, and lays from sixty to ninety eggs. These are laid separately and if on wheat, are placed in the furrow on the side of the kernel itself, one on each grain. The little caterpillar which hatches from the egg bores into the grain and feeds upon its contents until it is full grown, this process requiring about three weeks. At the end of this time the caterpillar is about one-fifth of an inch long and little of the grain is left except an outside shell. The caterpillar now cuts a part of a circular slit in this shell, leaving just enough of the circle uncut to hold the piece in place, and then forms a silken cocoon around itself within the grain. In this cocoon it transforms from the caterpillar to the moth and when this change has been completed the moth pushes out the circular piece cut by the caterpillar in the surface of the grain, and escapes. This usually occurs in August, and the moths therefore find themselves either in the stack, when threshing has not yet been completed, or wherever the grain has been stored. They now proceed to lay the eggs for a second brood which has a similar history. The work of this brood like that of the first is generally overlooked until the moths appear, at which time the abundance of the little "millers" around the bins and granaries, and the holes in the grains become noticeable. If the temperature of the place where the grain is stored be high enough, the moths lay their eggs for a third brood and if conditions permit will continue breeding through the winter. Usually, however, in Pennsylvania but two broods occur, and the insect passes the winter in whatever stage it happens to be when cold weather overtakes it.

Parasites and Treatment.

There are two foes to the Angoumois grain moth in Pennsylvania —a mite, and a minute insect known as *Catolaccus*. The latter has been quite abundant in this Commonwealth and has prevented some loss, but has failed to control the grain moth. Treatment should therefore be resorted to.

For the first brood of the grain moth nothing can be done as the insect is working inside the grain while it is yet uncut in the fields. After harvesting, however, the second brood can be cheaply and easily handled.

In order to successfully treat the grain at this time, it is desirable to thresh it as soon as possible after harvesting. Then when the grain has been placed in the bins it can be fumigated with carbon bisulfide and all the insects destroyed.

To properly use the carbon bisulfide the following directions should be followed: See that the bin is tight and that it can be closed so as to be fairly tight at the top, though this is less important. Place shallow dishes on the top of the grain and pour the carbon bisulfide into these; then close the bin and leave it undisturbed for twenty-four hours, after which the cover may be lifted and the bin left to air for an hour. Now stir over the grain to find if all the insects have been killed, and if any remain (which is not usually the case) repeat the treatment.

The quantity of carbon bisulfide to use depends on the size of the bin, the usual amount being one pound (costing twenty-five or thirty cents) to every thousand cubic feet contained in the bin. Thus one pound would be sufficient for a bin ten feet wide, ten feet long and ten feet high, and the amount of grain contained in it does not matter. To advantageously use the bisulfide in a bin, it may be divided between several dishes set on top of the grain, and as it begins to pass off as a gas into the air at once, the lid should be closed as soon as the bisulfide has been placed in the dishes. The gas it forms is heavier than the air and sinks through the grain, killing all the insects it reaches.

Two precautions in using this method should be mentioned. Avoid breathing the gas as far as possible as it is very disagreeable and in sufficient amount might be injurious. Avoid using the gas near flame or much heat of any kind as it catches fire easily and a lighted pipe in the mouth of a workman close by, or a lighted lantern within a few feet of the bin during the time treatment is going on might produce serious results. No injury of any kind is caused to the grain by this fumigation, and seed wheat seems to be as good for sowing afterwards as before.

This method of fumigation is also excellent for the destruction of the pea and bean weevil and other insects, and can also be used for the destruction of insects in cereals, meal, ground tobacco, and in fact in anything which can be placed in a box or bin tight enough to prevent the escape of the fumes of the bisulfide for a period of a day or more.

THE CODLING MOTH.

(Carpocapsa pomonella Linn.).

The Codling moth is perhaps responsible for more of the loss to our apple crop than any other insect. Its caterpillar, generally called the "apple worm," begins its attack soon after the fruit forms in the spring and destroys multitudes of apples before they are more than one-third grown. These are seldom taken into consideration, only those which are wormy later in the season being noticed. But these form a large proportion of the gathered crop where no treatment for the control of this insect is carried out, and the loss in the form of second or third class, where first class fruit could otherwise be obtained, reaches millions of dollars nearly every year—a loss which is wholly unnecessary as it can in large measure be avoided.

Life History.

The Codling moth spends the winter in the caterpillar stage snugly hidden under some loose piece of bark on the trunk of the apple tree or in equally protected places near by. In April usually, the caterpillar becomes a quiet pupa the skin of which is dark brown, and in this form remains for two or three weeks. At the end of this period the pupa opens and the adult Codling moth appears soon after the apple blossoms have fallen and the fruit which has "set" is beginning to enlarge. The eggs are now laid, one in a place, on the side of the apple, on its stem, or on a twig or leaf near by, a single moth laying between fifty and a hundred eggs. These eggs hatch in about a week and the tiny caterpillars crawl to the fruit to begin feeding. Probably about eighty out of every hundred of these caterpillars enter the apple at the blossom end which now faces upward or outward, but which as the apple grows larger will turn down with it until it is beneath the apple. Here at the blossom end of the fruit the caterpillar crawls in between the five little green projections (calyx lobes) which later dry up and turn black, and begins to eat into the substance of the apple, usually working to and around the core where it feeds for nearly a month or until it is full grown. It then eats its way to the outside of the apple and leaves it to find a place in which to become a pupa. If the apple it has fed in be still on the tree, the caterpillar on leaving it will probably crawl down the trunk until it finds a piece of loose bark beneath which it can crawl. Here it gnaws out an oval hollow in the bark, lines it with silk and becomes quiet. If the apple has fallen, however, any protected place the caterpillar can find will be taken in which to form its silk cocoon. This change usually occurs during July and the caterpillar may either remain quiet until the following spring, or in some cases become a pupa from which the adult moth soon comes to lay eggs for

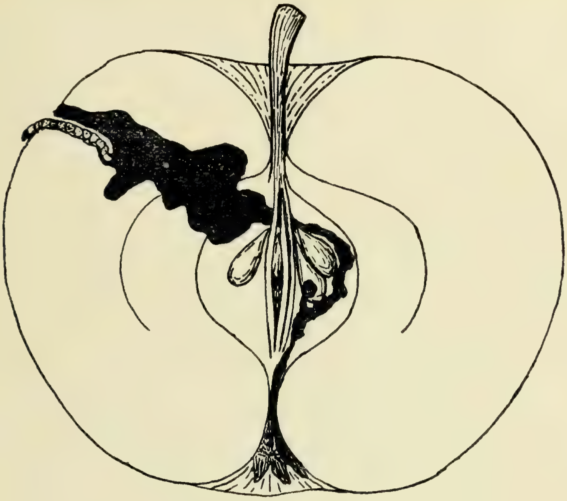

Fig. 5.—Apple, cut to show work of Codling Moth, with caterpiller leaving, at the side. Natural size.

a second brood. It is probable that both of these alternatives occur in Pennsylvania, some of these insects having two broods each year while others have but one. In cases where there is a second brood the eggs are laid in August or September, and the caterpillars feed as is the case with the spring brood except that a much smaller proportion appear to enter the fruit at the blossom end. If the caterpillars reach full growth before the apples are gathered they leave the fruit and conceal themselves under bark or elsewhere as already described. If carried in the apples to the bin, however, they find places in which to pass the winter, in crevices of the bin, or any place which may be available, forming pupæ there in the spring, like the others.

Treatment.

From the life history above outlined the best treatments available for this insect are evident. As the majority of the caterpillars feed first at the blossom end of the apple, and as these ends face upward at this time, spraying a few days after the blossoms fall, with Paris green or arsenate of lead, will, if properly done, place a little of the poison in the blossom end between the calyx lobes, just where the caterpillars will begin to feed. This method of treatment has been successful wherever tried. One precaution is necessary however. The calyx lobes at first stand apart, making a sort of cup into which to spray the poison. After a short time, however, they draw together closing this cup and it is then too late to spray in this manner with success.

The habit the caterpillar has of crawling down the trunk of the tree and hiding under some loose piece of bark during July, also gives an opportunity for treatment. The bark of the trunk and larger limbs of each tree should be carefully scraped about the twentieth of June, to leave no places under which the caterpillar can hide. Then a band of several layers of paper loosely tied around the trunk will provide a place in which they may gather. If these bands be turned over once a week during July and the first of August, and the caterpillars destroyed, many will be prevented from becoming adult to cause loss later. Birds aid in this work, often regularly visiting these bands and feeding on the caterpillars.

Fowls in the orchard destroy many of the caterpillars which have fallen to the ground in the fruit; careful cleaning of the apple bins and other places near where apples have been stored, early in the spring, will destroy many more, and if all these methods are made use of, the increased profit from the sales will many times more than pay for the cost and labor involved.

THE APPLE-TREE TENT CATERPILLAR.

(Clisiocampa americana Harr.)

This familiar pest on our apple trees is of importance only when neglected, as its presence becomes evident at an early stage. It feeds on the cherry, plum, peach and wild cherry as well as on the apple, and its tents at once call attention to its presence whenever they appear. It should be remembered, however, that the tents of this insect appear in the spring, while similar ones which become noticeable in the summer and fall are produced by other kinds of insects.

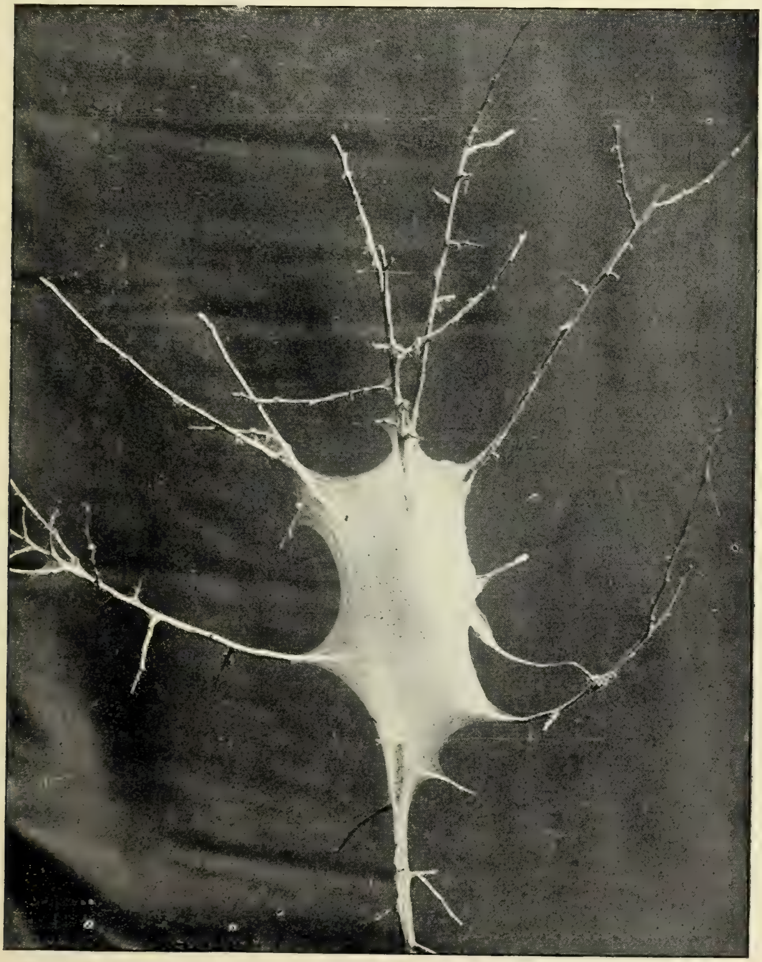

Fig. 6. -Tent of Apple-tree Tent Caterpillar. On the lower branch at the right is the egg mass from which the caterpillars hatched.

Life History.

The eggs of the apple-tree tent caterpillar are laid in July in the form of a ring or band around some small twig, each band containing from one hundred to three hundred eggs. At the edges the band which is half an inch or more in width is beveled down to the twig. The whole band is then covered by a brownish substance which hardens and forms a sort of varnish which conceals the individual eggs beneath.

The egg bands remain on the twigs from July until the leaf buds begin to open the following spring. At about this time, however, the eggs hatch and the little caterpillars crawl to some fork near by where they spin a tent, small at first, but enlarged from time to time as the caterpillars grow. From this tent the caterpillars go to feed, mornings and afternoons, returning to it at night, and in part, at least, about noon. Most of them also stay in the tent during rainy weather.

The caterpillars feed for five or six weeks before becoming full grown. As this condition is reached, each leaves the tent to find some protected place in which to spin a loose silken cocoon, within which it transforms from the caterpillar to the adult moth, a process requiring from two to three weeks. This change having been completed the moth appears sometime in July, and the eggs are laid from which caterpillars will appear the following spring. There is therefore but one brood a year.

Injury.

The amount of injury caused by this insect varies with its abundance. A full grown caterpillar will eat about two leaves a day and one tentful will therefore consume from two to six hundred leaves in this time. Averaging this rate of food consumption for the entire time they are feeding, we find that a tent containing two hundred caterpillars will consume over four thousand leaves in all. A vigorous tree would probably feel this but little, but a small tree, or a large one with a number of tents on it would be obliged to turn its energies to the putting forth of new leaves to take the place of those lost, just at the time when those energies should be devoted to the maturing of its fruit.

Treatment.

The treatment for this insect is simple, the fact that the caterpillars return to the tents at night making it easy to destroy these when all the caterpillars are together, either by means of a torch held under the tent, or better, by crushing tent and caterpillars with a gloved hand. In using the torch many of the insects drop to the ground and escape, while the flame is injurious to the tree—both being objections avoided by the other method. Spraying the tree with arsenate of lead or Paris green when the tents appear is also a successful treatment.

The eggs masses are often very noticeable, particularly while the trees are leafless, and should be cut off and burned, and every fruit grower should see that no tents of this insect should be permitted on the wild cherry and other trees along the roadsides near his orchards, unless he is prepared to find them present on his fruit trees the following spring, as a result. The continued presence of this insect in an orchard is evidence of neglect.

THE ROUND-HEADED APPPLE-TREE BORER.

(Saperda candida Fab.)

This insect is "next after the codling moth, the worst enemy to apple culture in America." The greater portion of its life is spent beneath the bark of the tree where it is only accessible to its enemies in a limited degree.

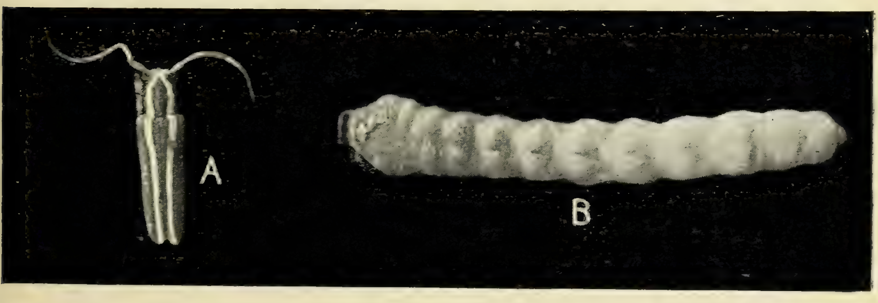

Fig. 7.—Round-headed Apple-tree Borer. A, Adult Beetle; B, full-grown grub. Both enlarged.

Life History.

The adult beetle which is rarely seen is about three-quarters of an inch long, grayish in color, and with two white stripes along its back. It lays its eggs during June, July and August in slits in the bark, usually near the ground. The young beetles which hatch in two or three weeks after the eggs are laid, bore into the inner bark and sapwood where they feed, making shallow cavities, often so near the surface that the bark over these cavities cracks and some of the "sawdust" falls out. During the winter the borers are quiet, but resume their work the following spring. During this second year they work deeper into the tree, boring in the heart wood, but at the approach of winter become quiet again. The next spring they bore out to the bark and then become quiet pupae for a short time, after which the adult beetle formed from the pupa during this stage gnaws through the thin layer of bark left over the hole and escapes.

Food Plants.

This borer works in the trunks of the apple, pear, quince, thorn, English hawthorn, Mountain ash, June berry and other trees.

Treatment.

To prevent this insect from laying its eggs on the tree, a wrapping of several thickness of paper may be placed closely around the trunk. The paper should be covered by a little earth at the bottom and reach up about two feet, and be closely tied, so that the beetles cannot get between it and the trunk. The wrapping should be applied about May 10th and remain at least until September

Wire window-screen netting can also be used for this purpose, care being taken that the lower edge of the netting be covered by the earth, and that some little space is left between it and the trunk except where it is fastened tightly around the tree about two feet above the ground. A protector of this kind will last for several years and if properly applied in the first place will need no attention.

Either of these methods will protect the lower part of the trunk; but as the beetle sometimes lays its eggs higher up, it is advisable to whitewash the trunk from the lowest fork down to the top of the protector at the time when this is put in place.

When borers are already in the trunk, their presence may often be discovered by the accumulation of sawdust around the base. In such cases the insects may be cut out with a knife, or if they are too far in to be conveniently reached in this way, a sharp-pointed flexible wire may be used with which to follow the hole and pierce the borer. Frequently when the burrow can be found, the most convenient treatment is to pour a little carbon bisulfide on some cotton, place the cotton in the hole and then plug up the hole outside, leaving the fumes of the gas to kill the borer.

THE PLUM CURCULIO.

(Conotrachelus nenuphar Herbst.)

The plum curculio is the cause of more loss to plum growers in this State than all other insects combined, fifty, sixty or even seventy-five per cent. of the plums often being destroyed by its attacks. Quite a part of this loss can be avoided, however, by using the proper methods, while if these are neglected the insect as it becomes more abundant in an orchard will also attack apples, pears, cherries and peaches injuring the appearance of these fruits and thus lessening their value, even when it does not prevent their reaching maturity.

Life History.

The plum curculio in its adult state is a little beetle about a quarter of an inch long, dark in color but with a few whitish markings on its roughened back, and with a snout on its head. It passes the winter hiding in any protected place it can find, and makes its appearance about the time the leaves open in the spring. While waiting for the plums to form, it feeds on the young leaves somewhat though doing little damage in this way, but when the blossoms have fallen and the plums have begun to grow, it proceeds to lay its eggs. To do this, it makes a small hole in the plum with its snout and in this hole it deposits an egg. It appears to realize, however, that unless farther precautions are taken, the rapid growth of the hard young plum will crush and destroy the egg, and it therefore cuts a crescent-shaped slit near where the egg was placed. The result of this is that the flesh of the plum between the egg and the slit wilts and remains soft, and crushing of the egg is thus prevented. Each curculio lays from fifty to one hundred eggs in this way and plums with six or eight slits and egg holes are frequently observed.

The eggs thus laid soon hatch and the young grubs eat into and around the stone, while the surface of the plum where the slits were made becomes gummy.

Around the stone the grub feeds till it is full grown, the time required for this being usually about three weeks. The grub then leaves the plum (which frequently falls off before this time, because of the presence of the grub) and enters the ground where it becomes quiet and transforms to a pupa from which the adult curculio appears a month or more later. Apparently this curculio does no injury during the remainder of the summer and fall but appears after wintering in some secluded place, to lay its eggs the following spring.

Treatment.

No one method of treatment is sufficient for this pest, but if the three given below be practiced, much loss will be prevented.

1. It has already been stated that in the spring the adult curculios feed on the young leaves until the plums have begun to grow. This fact may be taken advantage of by spraying the trees with Paris green, or better, with arsenate of lead just before the blossoms open, and repeating this treatment as soon as the blossoms have fallen. Do not spray while the trees are in blossom.

2. The adult curculios during the time they are feeding and laying their eggs, are sluggish mornings and evenings, though they will fly freely during the heat of the day and also on warm nights. This habit is successfully utilized by plum raisers who spread out sheets under the trees early in the mornings and then jar the trees by striking the trunks with a heavy mallet. The curculios fall onto the sheets and are gathered and destroyed. An improvement on this is to stretch canvas over a frame having sloping sides, and at the center opening into a tin can containing a little kerosene. A slit from the middle of one side to the center is not covered by the canvas but is left open so that the trunk of the tree may pass in through this to the center of the frame. A strip of canvas sewed to one side of the slit is then turned over to cover it and the canvas completely covers the ground under the tree. Such a frame mounted on a wheelbarrow can be conveniently and rapidly used and the curculios which fall upon the canvas when the trees are jarred, roll down the sloping sides of the frame and into the can of kerosene in the center. Plum orchards of hundreds of trees are every year treated in this way with great success, the trees being jarred every other morning.

3. The above methods will prevent multitudes of the curculios from laying a part or even any of their eggs, but it is equally important to destroy as many as possible of the grubs coming from eggs which have been laid. As a large proportion of the plums which have been "stung" by the curculios drop early, and as these grubs are readily eaten by fowls, it is advisable to let poultry and also hogs run freely in the orchards, or if this is not practicable, to gather the fallen plums and destroy them twice a day if possible, beginning about a week after the second spraying.

THE PEACH-TREE BORER.

(Sanninoidea exitiosa Say.)

The Peach-tree borer is one of the most serious enemies with which peach growers in this country have to contend. Much attention has recently been paid to this insect and many experiments have been made with a view to protecting the trees from its attacks, the results of which have somewhat changed our ideas as to the best methods to follow.

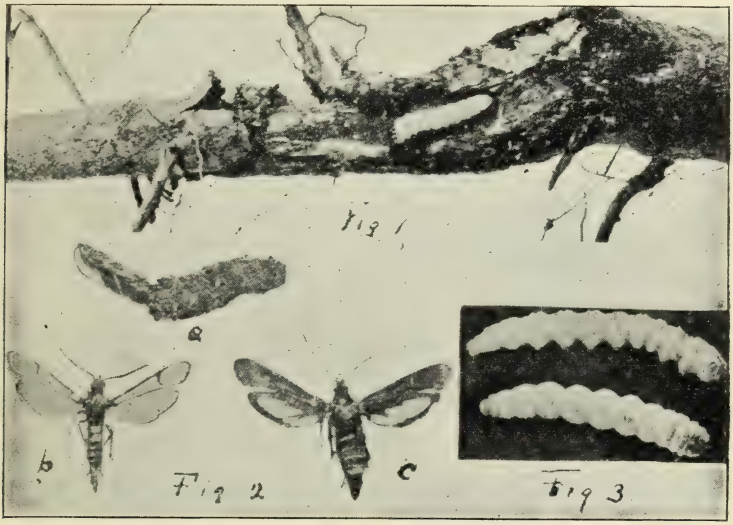

Fig. 8.—Peach Tree Borer. Plum root showing work of borer; 2 a, pupa case; b, male moth; c, female moth; 3, two grubs somewhat enlarged (From *Sirrine.*)

Life History.

The adult borer is a rather pretty, clear-winged moth, rarely seen by the peach grower. It appears in Pennsylvania early in June and lays its eggs on the bark of the peach tree, preferably near the ground, though they are sometimes placed as far up as the crotches of the lower branches. The egg soon hatches into a little grub which eats its way through the bark to the sapwood where it lives till fall, its feeding causing the production of masses of gum on the bark just outside where the borer is at work. At the approach of winter the grub ceases its work, but resumes operations again the following spring, and feeds until about the last of May or until it is full grown, when it is about an inch long. It then forms a quiet pupa which changes to the adult moth and leaves the tree early in June to lay its eggs for the next generation.

Treatment.

More than twenty different methods of treatment for this insect have been tested at different times, most of them proving of little value. Only those which have given the best results are considered here.

Mounding.—This treatment seems to be quite effective, keeping out "from one-half to seven-tenths of the borers." The earth should be mounded up around the trunk of the tree to the height of a foot or more, about the first of June, and should remain there till about the last of August, each year.

Paper Protectors.—These may be either of tarred paper or of several thicknesses of newspaper. The paper should be closely wrapped around the trunk, the lower edge of the wrapping being covered by the earth, and the upper edge being at least fifteen inches from the ground. The times of applying and removing the wrapping should be the same as for mounding.

Cutting Out.—This treatment is of course remedial rather than preventive and should be used together with the other methods given. It is desirable to cut out the borers in the fall before they have done much damage, but they are so small at that time that many are always overlooked, and it is therefore better practice to do this work about the first of May when the borers are large enough to be easily found. If cutting out each spring be followed by mounding or by wrapping the trunks as already explained, much of the loss by the attacks of the peach-tree borer can be prevented.

THE PEACH-TWIG BORER.

(Anarsia lineatella Zell.)

This insect is very abundant in Pennsylvania and does much damage though its presence is in most cases unknown to the peach grower, who, for this reason, is not aware of his loss from the attacks of this tiny moth.

Life History.

The little caterpillars of the peach-twig borer pass the winter in the spongy bark, chiefly of the smaller crotches of the tree, in small cavities they hollow out and which are marked by small masses of mixed bark and excrement projecting from the openings of the cavities. In the spring the caterpillars leave these cavities and pass to the leaf buds which they bore into, following along in the stem bearing the bud, eating its substance and causing the leaves to wilt and die. At this time their presence may be discovered by looking for the wilted tufts of leaves which are very noticeable among the others not thus affected. After boring out one shoot the caterpillar passes to another which it destroys in the same way, and it may attack several before becoming full grown. When the caterpillar has reached full size, it forms a small web either in withered leaves on the tree, in leaves or rubbish around the tree, or it may lie exposed on the bark. In either case it now remains quiet for a week or ten days, at the end of which time the internal changes necessary having been completed, the adult moth appears and lays eggs for a new brood. The caterpillars which hatch from these eggs attack new growth of the tree, entering the young twigs where these give off leaves, or sometimes entering the stems of the young fruit, and later, in some cases, boring into the fruit itself. This history is probably repeated by the next brood, and in the fall the eggs for the third brood are probably laid on the bark and the little caterpillars burrow into the bark to pass the winter. There are therefore three broods each year.

Injuries.

The spring brood which passes the winter in cavities in the bark at the crotches, is the one which is most noticeably injurious. As it bores into shoot after shoot in the spring, the number of these which are killed when the insect is abundant is very great, often several hundred of the young shoots on a single tree being destroyed. The result of this upon the tree is to make it scraggy and irregular and to cause it to expend its energy in the formation of new growth at a time when this energy should be devoted to the production of fruit.

Treatment.

The best method of control for this insect which has as yet been found, is to spray the trees in winter to destroy the caterpillars which are then in cavities in the bark at the crotches.

To successfully carry out this method it is advisable to lightly scrape the larger crotches with some blunt edged instrument—a hoe has been found to be well adapted to this purpose. After scraping in this way the tree should be sprayed with kerosene emulsion, made and applied as follows:

Kerosene, ...	2	gallons.
Whale-oil soap, ...	½	pound.
Water, ...	1	gallon.

"The soap, first finely divided, is dissolved in the water by boiling and immediately added boiling hot away from the fire to the kerosene. The whole mixture is then agitated violently while hot, by being pumped back upon itself with a large force pump and direct discharge nozzzle throwing a strong stream, preferably one-eighth inch in diameter. After from three to five minutes pumping the emulsion should be perfect and the mixture will have increased from one-third to one-half in bulk and assumed the consistency of cream. Well made, this emulsion will keep indefinitely, and should be diluted only as wanted for use." To use it, add six gallons of water to a gallon of the emulsion or at that rate. If hard water must be used either in making or in diluting the emulsion for use, add about one-quarter more soap. Spray long enough to thoroughly wet the bark, but not long enough to let the emulsion stand in the crotches in little pools as this would have an injurious effect upon the tree.

PLANT LICE.

(Aphididae.)

Plant lice or Aphids are always an important pest to crops and to flowers as well. They appear early in the spring, often before the plants they feed upon have made a good start, and as they multiply with great rapidity, sometimes cause much loss.

Nearly every plant, shrub and tree has one or more kinds of plant lice which attack it, and in seasons favorable to their rapid increase may so check growth as to seriously injure the crop.

Among the most important plant lice with which the farmer and fruit grower come in contact are the wooly apple louse, often present along scars on apple limbs in the fall, and very noticeable because of the white wooly threads it produces; the green apple louse, often so abundant in spring on the leaves; the black louse on the plum; the wheat Aphis; the pea-vine louse; the cabbage louse; the currant louse; the rose louse and the corn Aphis.

In many cases the first evidence of the presence of plant lice is the curling of the leaves which is often particularly noticeable on cherry and plum trees in May. Often, however, the plant lice are not seen in large numbers till later, in the summer or even fall.

Life History.

No accurate description of the life history of plant lice in general can be given, as different species of these insects have different histories. A few general facts, however, will apply to nearly all.

In a general way it may be stated that plant lice pass the winter in the egg state, and hatch about the time the buds open in the spring. Each is then a tiny insect with six legs and no wings, which crawls about and sucks the sap from the plant on which it is by means of a sharp-pointed beak which it thrusts through the bark or epidermis of the plant till it reaches the sap. In the course of a few days it becomes adult and begins to produce young, giving birth to three or four a day. These young also become adult in a few days and in their turn produce young, and in this way there may be many generations during the summer. Some one or more of these generations will develop wings and pass to the other plants, thus distributing the insects over the region. In the fall some generation instead of giving birth to young, will lay eggs, and these will winter over and hatch the following spring.

Treatment.

As plant lice are sucking insects, no stomach poison such as Paris green or arsenate of lead is of any value to destroy them, and kerosene emulsion is the most effective remedy made use of. In order to kill the lice, however, every insect must be touched by the oil and this requires careful and thorough spraying. As the lice are usually on the under surface of the leaves the spray must be thrown upward against the lice, and after the leaves begin to curl this is very difficult if not impossible. It is necessary, therefore, that the trees should be carefully watched, and be sprayed as soon as the lice appear, and before they have become so abundant as to cause the leaves to begin to curl.

In places where it can be obtained, a strong stream of cold water thrown through a hose upon a tree infested with plant lice, is very effective as it knocks the lice off the tree and kills nearly all of them, but too often this treatment is not available.

In the case of the pea-vine louse, the peas grow in such a way that it is difficult to reach the lice by spraying, and here the best practice is to follow along the rows on a hot day with a branch from some evergreen tree, or a piece of brush, and switch the lice off the vines onto the ground, which can be easily and rapidly done. A cultivator should then follow along the rows and loosening the dry, hot soil, the lice will be dried up by it and die before they are able to return to the plants from which they had been switched off.

SPRAYING MATERIALS.

The chief materials for spraying here suggested are Paris green, arsenate of lead and kerosene emulsion. It is well to speak more fully of these substances as one-half of the value of spraying depends upon whether they are properly made or not, while the other half is determined by when and how they are applied. Combinations of insecticides and fungicides are also important for if these can be applied together rather than separately much time and labor can be saved. A short consideration of these points, therefore, should be of value.

Paris Green.

This insecticide which has been used in quantities for the destruction of insects longer than any other, is a chemical combination of arsenic, copper and acetic acid. The arsenic (arsenious oxide) is of course the poisonous substance, and a good Paris green should contain over fifty per cent. of it. Much that is on the market, however, contains less than this amount, and is known as "Low grade Paris green," and is worth less for use than the higher grades (though it is generally sold at about the same price as the better article), as the farmer who uses it is putting less poison on his crops than he supposes.

In some States, laws have been enacted requiring that all Paris green sold should contain at least fifty per cent. of arsenic—a law that has frequently done more harm than good—and in order to comply with it, manufacturers sometimes produce a low grade article, and during its manufacture or afterwards, add enough arsenic to bring the percentage of this substance up to that required by the law. But the arsenic thus added does not chemically combine with the other substances present in the Paris green, but remains as free arsenic which burns the leaves badly as everyone who has used much Paris green knows. In this way a poor quality of Paris green which would cause little or no burning of the foliage, becomes, by the addition of the free arsenic, a dangerous substance to apply to leaves of any kind.

Another objection to Paris green is that it is frequently adulterated with other substances, such as flour or plaster. Though such adulterations do no harm when applied to foliage, the purchase of such Paris green is much more expensive than it would be to buy these materials separately and mix them.

A further objection to Paris green is that some of the arsenic actually combined with the copper and acetic acid appears to dissolve in water in the spraying tank, and in this way even a reliable article may sometimes cause burning.

Finally, Paris green when mixed with water is quite heavy and tends to settle to the bottom of the tank, and though all good spray pumps are provided with an automatic agitator, the amount of the poison sent out when the tank is full and when it is nearly empty will differ considerably and the results will be correspondingly unreliable.

For these reasons Paris green is less favorably looked upon as an insecticide than was once the case, and other materials are being more used each year in its place.

Arsenate of Lead.

This substance is a chemical combination of arsenic and lead, and as the arsenic in it is all combined, no burning from its use results, no matter how strong it is made. It is therefore safe to use on all kinds of trees.

It is lighter than Paris green, needing little stirring to keep it from settling, and it adheres to the leaves a much longer time, it generally being necessary to spray but twice with it where three times would be needed with Paris green. Thus, though it costs a little more, this cost is more than an off-set by the reduction in number of treatments necessary.

It is made as follows:

Arsenate of soda (50 per cent. strength), . .	4 ounces.
Acetate of lead, ...	11 ounces.
Water, ...	150 gallons.

Put the arsenate of soda in two quarts of water in a wooden pail, and the acetate of lead in four quarts of water in another pail, also of wood. When the chemicals are all dissolved, pour the contents of both pails into the spraying tank with the rest of the water, and stir for a few minutes before using.

Those who prefer to make use of arsenate of lead ready prepared can obtain it from the Bowker Insecticide Company, 43 Chatham street, Boston, Mass., by whom it is sold under the name of Disparene, or from several other firms which supply this article.

Kerosene Emulsion.

Paris green and arsenate of lead are termed stomach poisons, and are used for insects which bite off and swallow solid food. Kerosene emulsion is a contact poison and is used for those insects which suck the juices from plants and which cannot therefore be destroyed by stomach poisons.

Where a contact poison is used it is necessary to touch each insect with a drop of the spray in order to destroy it, while a stomach poison may be spread upon the leaves for the insect to eat with its food at any time it may happen to reach it. Spraying with contact poisons is, therefore, much more difficult than with stomach poisons.

Kerosene emulsion is usually made as follows:

Hard soap, shaved fine, ...	½ pound.
Water, ...	1 gallon.
Kerosene, ...	2 gallons.

Dissolve the soap in the boiling water; remove it from the fire and pour it into the kerosene while hot. Churn this with a hand spray pump until it changes to a creamy, then to a soft butter-like mass. This may be used as a stock, and should keep for some time. For use, take one part of the stock and nine parts of water for plant lice, though where the insects to be treated have harder bodies, one part of the stock to four or five parts of water can be used to advantage.

Insecticides and Fungicides.

It is important to spray fruit trees before they blossom, with Bordeaux mixture to destroy fungous diseases, and as this is also the time to spray for many insects it is often desired to use the insecticide and fungicide together. This can be easily done, the Bordeaux mixture combining well, both with Paris green and arsenate of lead, and the following directions give the best methods for preparing these combined sprays:

Bordeaux Mixture and Paris Green.

Bordeaux mixture, ...	50 gallons.
Paris green, ...	4 ounces.

Stir the two till well mixed before using.

Bordeaux Mixture and Arsenate of Lead.

Prepare the arsenate of lead as already directed, but instead of adding the two chemicals when dissolved, to the rest of the water in the spraying tank, add them to fifty gallons of the Bordeaux mixture placed in the tank and stir for a few minutes before using.

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN NO. 100.

CONTAINING A LIST OF LICENSES

GRANTED BY THE

DAIRY AND FOOD COMMISSIONER

FROM

January 1, 1902, to June 30, 1902; Together with a List of
Analyses of Food Samples taken, and a Record
of Suits and Prosecutions Brought
During that Period.

COMPILED BY

GEORGE G. HUTCHISON,

Clerk in the Dairy and Food Division of the Department of Agriculture of Pennsylvania.

PUBLISHED BY DIRECTION OF THE SECRETARY.

WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA.
1902.

VIRTUE
LIBERTY AND
INDEPENDENCE

PREFACE.

Harrisburg, Pa., August 6, 1902.

The following Bulletin No. 100, giving a tabulated statement of the work of the Dairy and Food Division of the Department of Agriculture, is published in compliance with the requirements of the acts of Assembly of May 29, and July 10, 1901. The compilation was made by George G. Hutchison, clerk of this Division, and embraces samples taken and suits and prosecutions brought from January 1, to June 30, 1902. An analysis of the bulletin, as presented in the letter of transmittal by the Dairy and Food Commissioner, shows, in condensed form, the variety of food products examined and the large amount of work that has been performed in enforcing the several laws regulating the purity of food products in this State.

JOHN HAMILTON,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

Harrisburg, Pa., August 5, 1902.

Hon. John Hamilton, *Secretary of Agriculture, Harrisburg Pa.:*

My Dear Sir: In compliance with the requirements of the act of Assembly, approved May 29, A. D. 1901, and of the act, approved July 10, A. D. 1901, I have the honor to submit to you a bulletin, compiled by George G. Hutchison, clerk of this Division, containing a list of oleomargarine and renovated butter licenses issued from January 1, to June 30, 1902, as follows: Oleomargarine licenses; one manufacturers, five wholesale, 181 retail, six hotel and restaurant and one boarding house; one manufacturers renovated butter license; a statement of the samples taken by the agents and analyzed by the chemists; a tabulated statement of suits and prosecutions brought from January 1, to June 30, 1902, giving a detailed statement of cases by counties, the agent's and docket numbers, name and address of defendants, date of information, date of hearing and form of action, the name and address of the magistrates, the disposition and final determination of the cases.

This bulletin, which covers a period of six months, contains the following number of samples: Oleomargarine, 193; butter, ninety-three; renovated butter, thirty-four; pure food, 424; milk, forty-nine; cheese, seven; vinegar, forty-nine. Of the 424 samples analyzed under the pure food act, 191 proved to be pure, 161 adulterated, forty-three contained a preservative and twenty-nine contained coloring matter.

Of the forty-nine samples of milk, thirty-nine were pure, eight adulterated, one contained a preservative and one coloring matter.

Of the seven samples of cheese, two were full cream and five were below standard.

Of the forty-nine samples of vinegar, twenty-two were pure, twenty-one adulterated and six contained coloring matter.

You will find contained in this bulletin the following suits and prosecutions under the several acts.

Oleomargarine act of 1901, 181 cases. Of these, thirty-seven are terminated and 141 are pending.

Renovated butter act of 1901, twenty-five cases. Of these, six are terminated and nineteen are pending.

Pure food act of 1895, ninety-seven cases. Of these, sixty-three are terminated and thirty-four are pending.

Milk act of 1897, amended 1901, five cases. Of these, three are terminated and two are pending.

Cheese act of 1897, amended 1901, three cases. Of these, one is terminated and two are pending.

Lard act of 1891, six cases. Of these, five are terminated and one is pending.

Vinegar act of 1897, amended 1901, seven cases. Of these, four are terminated and three are pending.

Prosecuted by citizens, under the provisions of Oleomargarine act of 1901, thirty-one cases. Of these, one is terminated and thirty are still pending.

In Bulletins Nos. 82 and 92, previously issued, and which cover a period of two years, the following cases were prosecuted:

Oleomargarine, 1,330; butter, two; renovated butter, twenty-six; pure food, 233; milk, sixty-eight; condensed milk, two; cheese, seven; vinegar, fifteen; lard, one. Total, 1,684.

None of these cases are carried into this bulletin. The majority of them have been terminated, fines and costs received and paid into the State Treasury.

Very respectfully,
JESSE K. COPE,
Dairy and Food Commissioner.

PART I.

LIST OF LICENSES

ISSUED BY THE

Dairy and Food Commissioner

FROM

JANUARY 1, 1902, TO JUNE 30, 1902.

ARRANGED BY COUNTIES.

LIST OF LICENSES ISSUED FROM JANUARY 1, TO JUNE 30, 1902.

Number.	Name and Address.	Kind.	Date Issued.	Expires.
	ALLEGHENY COUNTY.			
1145	Geo. W. Ruppert, 909 East St., Allegheny, Friendship Butter Co.	Retail, ...	Jan. 1,....	Dec. 31.
1146	H. F. Levi, 822 Federal St., Allegheny, Economy Butter Co.	Retail, ...	Jan. 1,....	Dec. 31.
1147	H. F. Levi, 860 Ohio Street, Allegheny, Liberty Dairy Co.	Retail, ...	Jan. 1,....	Dec. 31.
1148	H. F. Levi, 1620 Beaver Av., Allegheny, Economy Butter Co.	Retail, ...	Jan. 1,....	Dec. 31.
1149	James A. Hazlet, Gains St., Tarentum, ...	Retail, ...	Jan. 1,....	Dec. 31.
1150	Mrs. Mary Smith, 2230 Fifth Av., Pittsburg. This license transferred July 22, 1902, to H. B. Smith.	Retail, ...	Jan. 1,....	Dec. 31.
1151	J. B. Steen, 5932 Penn Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1152	Frank L. Andrews, 4828 Penn Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1153	Samuel A. McCutcheon, 819 Wood St., Wilkinsburg,	Retail, ...	Jan. 1,....	Dec. 31.
1154	Paul Hughes, 564 Homewood Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1155	Highland Supply Company, 62 Frankstown Av., Pittsburg, J. B. Imhoff, prop.	Retail, ...	Jan. 1,....	Dec. 31.
1156	Adams Weitzel, 99 Washington St., Pittsburg. This license transferred May 14, 1902, to 84 Washington Av., as holder was compelled to move.	Retail, ...	Jan. 1,....	Dec. 31.
1157	Mrs. Pauline Fox, 1108 Braddock Av., Braddock, ...	Retail, ...	Jan. 1,....	Dec. 31.
1158	Evan Thomas, 656 Preble Av., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1160	Geo. S. Daugherty & Co., 1205 Carson St., Pittsburg.	Retail, ...	Jan. 1,....	Dec. 31.
1161	J. J. Anthony, 121 East Ohio St., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1162	J. J. Anthony, 18 Diamond Square, Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1163	W. E. Bunting, 300 Frankstown Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1164	Grant S. Richards, Penn Av., Turtle Creek, ...	Retail, ...	Jan. 1,....	Dec. 31.
1165	R. S. Jones, 2108 Carson St., Pittsburg. Transferred March 18, 1902, to F. Finkel.	Retail, ...	Jan. 1,....	Dec. 31.
1169	Geo. Schmitt, 102 Wilkins St., Allegheny. This license transferred May 14, 1902, to 25 McClure Av., holder had to move.	Retail, ...	Jan. 1,....	Dec. 31.
1173	C. L. Morrow, Semmens Building, Penn Av., Turtle Creek.	Retail, ...	Jan. 1,....	Dec. 31.
1174	Harper & Wynne, 1734 Fifth Av., Pittsburg, W. J. Harper & D. R. Wynne.	Retail, ...	Jan. 1,....	Dec. 31.
1175	F. A. Hawley, 516 Fifth Av., McKeesport, ...	Retail, ...	Jan. 1,....	Dec. 31.
1176	A. J. McQuiggan, 552-552½ Main St., Braddock, ...	Retail, ...	Jan. 1,....	Dec. 31.
1177	Walter J. McBeth, 564 Braddock Av., Braddock, ...	Retail, ...	Jan. 1,....	Dec. 31.
1178	Ed. J. Rauch, 103 Southern Av., Knoxville, ...	Retail, ...	Jan. 1,....	Dec. 31.
1179	Holland Butterine Company, 518-526 First Av., Pittsburg, W. W. Prince, manager,	Manuf'r, .	Jan. 1,....	Dec. 31.

LICENSES—Continued.

Number.	Name and Address.	Kind.	Date Issued.	Expires.
1180	B. L. Shoemaker, 6 N. Duquesne Av., Duquesne, ..	Retail, ...	Jan. 1,....	Dec. 31.
1181	H. Watson, 196 Main St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1182	W. C. Staving, Stand 204 Allegheny Market, Allegheny.	Retail, ...	Jan. 1,....	Dec. 31.
1183	Margaret Gardner, Penn Av., Turtle Creek, ...	Retail, ...	Jan. 1,....	Dec. 31.
1184	John M. Deen, 523 Rebecca St., Wilkinsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1185	Fred. Preach, 4505 Liberty St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1186	Mrs. M. Mooney, 117 Grant St., Millvale, ...	Retail, ...	Jan. 1,....	Dec. 31.
1187	Dan Jordan, Stand 21 Pittsburg Market, Pittsburg,..	Retail, ...	Jan. 1,....	Dec. 31.
1188	N. J. Miller, Butler Street, Etna, ...	Retail, ...	Jan. 1,....	Dec. 31.
1189	Corcoran & Booth, 107 Third Av., Pittsburg, ...	Wholes'e,	Jan. 1,....	Dec. 31.
1190	F. E. Richards, Stand 87 Allegheny Market, Pittsburg.	Retail, ...	Jan. 1,....	Dec. 31.
1191	W. M. Swindler & Co., 432-434 Market St., Pittsburg,	Retail, ...	Jan. 1,....	Dec. 31.
1192	John G. Messner, 413-415 Market St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1193	James Reid, 205 Eighth Av., Homestead. Transferred July 25, 1902, to P. M. Corrigan.	Retail, ...	Jan. 1,....	Dec. 31.
1194	Stenger Brothers, 921 Wylie Av., Pittsburg, Martin & James Stenger.	Retail, ...	Jan. 1,....	Dec. 31.
1195	H. C. Woods, 45½ Southern Av., Pittsburg. Transferred to 419 Mill St., Coroapolis, Pa., as holder had to move.	Retail, ... Retail, ...	Jan. 1,.... Jan. 1,....	Dec. 31. Dec. 31.
1196	K. Rein, Stands 30-32 S. S. Market, Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1197	W. S. White, 84 Fourth Av., Coroapolis, ...	Retail, ...	Jan. 1,....	Dec. 31.
1200	Mrs. Sarah Powers, 1312 Fifth Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1201	Pittsburg Poultry Company, 410 Market St., Pittsburg.	Retail, ...	Jan. 1,....	Dec. 31.
1203	McCann & Co., 401-403 Market St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1204	McCann & Co., 401-403 Market St., Pittsburg, ...	Wholes'e,	Jan. 1,....	Dec. 31.
1205	George Ritter, 511 Main St., Sharpsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1207	Elgin Supply Company, 59 Shiloh St., Pittsburg, R. S. Graham.	Retail, ...	Jan. 1,....	Dec. 31.
1208	E. Maxwell, Stands 2-4 Market House, McKeesport,	Retail, ...	Jan. 1,....	Dec. 31.
1209	C. F. Marshall, 1318 Juniata St., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1210	W. Brown, 414 Jackson St., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1211	E. A. Moschel, 1800 Carson St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1212	William J. Moxley, 407 Ferry St., Pittsburg. This license transferred April 30, 1902 to 109 Third Av., as holder had to move.	Wholes'e,	Jan. 1,....	Dec. 31.
1213	A L. Ritchie, 436 Market St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1214	J. E. Gibson, 197-198-206 Allegheny Market, Allegheny.	Retail, ...	Jan. 1,....	Dec. 31.
1215	W. H. Gamble, 916 Evans St., McKeesport, ...	Retail, ...	Jan. 1,....	Dec. 31.
1216	W. S. Kregar, 228 Brushton St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.

LICENSES—Continued.

Number.	Name and Address.	Kind.	Date Issued.	Expires.
1217	Hugh McCambridge, 600 Herron Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1218	James Campbell, 341 Fifth St., McKeesport, ...	Retail, ...	Jan. 1,....	Dec. 31.
1219	Campbell Brothers, 914 Walnut St., McKeesport, ...	Retail, ...	Jan. 1,....	Dec. 31.
1222	F. R. Kithcart, 300 Liberty Market, Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1223	J. L. Ackerman, 1800 Centre Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1225	J. W. Price, 415 Walnut St., Versailles, ...	Retail, ...	Jan. 1,....	Dec. 31.
1226	John Houston, 178-179 Allegheny Market, Allegheny,	Retail, ...	Jan. 1,....	Dec. 31.
1227	Fosnight & Auth, 206 S. Main St., W. E. Pittsburg, P. J. & P. F. Fosnight & F. T. Auth.	Retail, ...	Jan. 1,....	Dec. 31.
1228	C. Limberg, 720 Second St., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1229	C. Limberg, 868 Ohio St., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1231	Tilbrook & Co., Broadway, Pitcairn, I. M. Tilbrook & J. T. Tilbrook.	Retail, ...	Jan. 1,....	Dec. 31.
1232	Depp Brothers & Co., 14 Fourth Av., Carnegie, Geo. W. Depp.	Retail, ...	Jan. 1,....	Dec. 31.
1233	Western Supply Company, 319 Fifth Av., McKeesport, Hugh McDermott.	Retail, ...	Jan. 1,....	Dec. 31.
1234	B. Kripp, 51 S. 12th St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1235	S. B. Charters, Third Av. & Grant St., Pittsburg,	Retail, ...	Jan. 1,....	Dec. 31.
1237	Elgin Supply Company, 2136 Fifth Av., Pittsburg, G. W. Kripschild.	Retail, ...	Jan. 1,....	Dec. 31.
1239	A. Appel, Jr., 41 Diamond Market, Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1240	Frank J. Wesley, 4011 Butler St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1241	William Sheehan, 213 Fifth Av., McKeesport, ...	Retail, ...	Jan. 1,....	Dec. 31.
1242	Samuel G. Shoop, 1201 Federal St., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1243	E. A. Hill, S. Canal Street, Tarentum, ...	Retail, ...	Jan. 1,....	Dec. 31.
1248	Walter J. Kerr, 435 Beaver Av., Sewickley, ...	Retail, ...	Jan. 1,....	Dec. 31.
1250	B. M. Quinn, 845 Main St., Braddock, ...	Retail, ...	Jan. 1,....	Dec. 31.
1251	Sheehan & Cavenaugh, 223 Eighth Av., Homestead,	Retail, ...	Jan. 1,....	Dec. 31.
1252	Sheehan & Cavenaugh, 313 Market St., Pittsburg, ..	Retail, ...	Jan. 1,....	Dec. 31.
1254	J. R. Martin, 201-202 Allegheny Market, Allegheny,	Retail, ...	Jan. 1,....	Dec. 31.
1255	F. G. Bishoff, Mgr., 315 W. Braddock Av., Rankin, Fayette Butter Co.	Retail, ...	Jan. 1,....	Dec. 31.
1256	P. Linaugh, 5022 Penn St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1257	P. M. Corrigan, 1905 Penn Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1258	H. Wells, 318 Brushton Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1265	Louis Nease, 630 Braddock Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1266	Louis Nease, 201 Main St., W. E. Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1267	Louis Nease, 3541 Butler St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1268	E. J. Dunn, 866 Braddock Av., Braddock, ...	Retail, ...	Jan. 1,....	Dec. 31.
1269	E. J. Dunn, Cor. 8th Av. and McClare St., Homestead.	Retail, ...	Jan. 1,....	Dec. 31.
1270	A. Braun, Stand 194 Alleg. Market, Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1271	Mary A. Guttendorf, 2624 Carson St., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31,

LICENSES—Continued.

Number.	Name and Address.	Kind.	Date Issued.	Expires.
1273	Nicholas Huber, Prop., 2158 Wylie Av., Pittsburg, Purity Dairy Co.	Retail, ...	Jan. 1,....	Dec. 31.
1275	J. J. Rungee, 185 Liberty Market, Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1276	George H. Callahan, 821 Main Street, Braddock, ...	Retail, ...	Jan. 1,....	Dec. 31.
1277	J. D. Wilson, Prop., 2102 Carson St., Pittsburg, Excelsior Butter Co.	Retail, ...	Jan. 1,....	Dec. 31.
1281	George B. Henderson, 128 Frankstown Av., Pittsburg,	Retail, ...	Jan. 1,....	Dec. 31.
1282	Chris. Hassler, Railroad St., Wilmerding, ...	Retail, ...	Jan. 1,....	Dec. 31.
1283	McMichael & Co., 700 Jenny Lind St., McKeesport, C. E. McMichael & J. W. Taylor.	Retail, ...	Jan. 1,....	Dec. 31.
1284	McMichael & Co., 1327 Fifth Av., McKeesport, C. E. McMichael & J. W. Taylor.	Retail, ...	Jan. 1,....	Dec. 31.
1286	Thomas S. Williams, 600 Preble Av., Allegheny, ...	Retail, ...	Jan. 1,....	Dec. 31.
1290	R. Lowenstein, 74 Frankstown Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1291	L. A. Brooks, Station St., Wilmerding, ...	Retail, ...	Jan. 1,....	Dec. 31.
1292	S. J. Shaw & Co., Westinghouse Av., Wilmerding, ..	Retail, ...	Jan. 1,....	Dec. 31.
1293	C. G. & L. E. Jones, 1901 Centre Av., Pittsburg, Transferred April 4, 1902, to Albert Burgess.	Retail, ...	Jan. 1,....	Dec. 31.
1294	J. L. Brown, 612 Homewood Av., Pittsburg, ...	Retail, ...	Jan. 1,....	Dec. 31.
1301	James L. O'Donnell, 64 Washington Av., Pittsburg,	Retail, ...	Jan. 1,....	Dec. 31.
1302	Mary F. Smith, 425 Mill St., Coroapolis, ...			
1303	N. H. Brady, 103 Third Av., Pittsburg, ...	Wholes'e,	Jan. 1,....	Dec. 31.
1304	J. L. Vaughan, 207 Fourth Av., Carnegie, ...	Retail, ...	Jan. 1,....	Dec. 31.
1305	Austin M. Embrey, Mgr., 5941 Centre Av., E. E. Pittsburg, Liberty Market.	Wholes'e,	Jan. 1,....	Dec. 31.
1307	Smith Hostetter, Highland and Third Sts., Pitcairn.	Retail, ...	Jan. 1,....	Dec. 31.
1310	Bryan & Bradshaw, 509 Locust St., McKeesport, ...	Retail, ...	Jan. 1,....	Dec. 31.
1312	M. J. Laughlin, 222 Fifth Av., McKeesport, National Hotel.	Hotel, ...	Jan. 1,....	Dec. 31.
1317	J. J. Wise, 811 Fifth Av., McKeesport, ...	Retail, ...	Feb. 1,....	Dec. 31.
1318	E. C. Speelman, 1017 Walnut St., McKeesport, ...	Retail, ...	Feb. 1,....	Dec. 31.
1322	B. M. Quinn, 814 Main St., Braddock, ...	Retail, ...	Feb. 1,....	Dec. 31.
1323	Henry Ehrhardt, 135 Allegheny Market, Allegheny,	Retail, ...	Feb. 1,....	Dec. 31.
1324	D. W. Campbell, 3625 Butler St., Pittsburg, ...	Retail, ...	Feb. 1,....	Dec. 31.
1325	H. C. Swartz, 411 Grant St., Bennett, ...	Retail, ...	Feb. 1,....	Dec. 31.
1326	Mrs. R. B. Bennie, Cor. Anderson and Isabella Sts., Allegheny.	Brdg. Hse.	Feb. 1,....	Dec. 31.
1330	W. H. Speaker, 15 Wabash Av., Pittsburg, ...	Retail, ...	Mar. 1,....	Dec. 31.
1332	C. G. Hoover, Stall 24 Allegheny Market, Allegheny,	Retail, ...	Mar. 1,....	Dec. 31.
1333	Sheehan & Cavenaugh, 301 Market St., Pittsburg, ..	Retail, ...	Mar. 1,....	Dec. 31.
1334	Geo. W. Depbaugh, 4802 Second Av., Pittsburg, ...	Retail, ...	Mar. 1,....	Dec. 31.
1336	Alfred Watson, 329 Chartiers Av., McKees Rocks,	Retail, ...	Mar. 1,....	Dec. 31.
1338	Morrison Brothers, Penn Av., Turtle Creek, J. S. & D. Morrison.	Retail, ...	Mar. 1,....	Dec. 31.

LICENSES—Continued.

Number.	Name and Address.	Kind.	Date Issued.	Expires.
	ARMSTRONG COUNTY.			
1202	Fred Meyers, 63 S. Jefferson St., Kittanning,	Retail,	Jan. 1,	Dec. 31.
	BEAVER COUNTY.			
1221	L. Richards, 126 12th St., Beaver Falls,	Retail,	Jan. 1,	Dec. 31.
1224	George W. Vandervort, Washington St., Rochester. This license transferred April 23, 1902 to 286 Jackson St., as holder was compelled to move.	Retail,	Jan. 1,	Dec. 31.
1274	Ewing Brothers, 1212 Seventh Av., Beaver Falls,	Retail,	Jan. 1,	Dec. 31.
1285	A. G. Harvey, 831 Third Av., New Brighton,	Retail,	Jan. 1,	Dec. 31.
1297	C. H. Niehaus, Vermont St., Rochester,	Retail,	Jan. 1,	Dec. 31.
1298	R. J. Jamison, Cor. Third and Sixth Avs., Beaver Falls.	Retail,	Jan. 1,	Dec. 31.
1300	Joseph McFerron, 1102 Seventh Av., Beaver Falls,	Retail,	Jan. 1,	Dec. 31.
1311	W. M. McCandless, 2406 Eighth Av., Beaver Falls,	Retail,	Jan. 1,	Dec. 31.
1316	J. J. Patterson, 1628 Fifth Av., Beaver Falls,	Retail,	Feb. 1,	Dec. 31.
	BLAIR COUNTY.			
1321	A. L. Ritchie, 1607-1609 11th Av., Altoona,	Retail,	Feb. 1,	Dec. 31.
1342	Mrs. Belle Kayes, 1114 Eighth Av., Altoona,	Brdg. Hse.	May 1,	Dec. 31.
	BUTLER COUNTY.			
1296	A. E. Meyers, 109 E. Jefferson St., Butler,	Retail,	Jan. 1,	Dec. 31.
	CAMBRIA COUNTY.			
1249	Philip E. Caulfield, 241 Franklin St., Johnstown,	Retail,	Jan. 1,	Dec. 31.
1329	Benjamin Reese & W. Roden, 817 Franklin St., Johnstown.	Retail,	Jan. 1,	Dec. 31.
	CENTRE COUNTY.			
1337	George H. Richards, 120 Front St., Philipsburg,	Retail,	May 1,	Dec. 31.
	ERIE COUNTY.			
1245	M. J. Olds & Son, 1125 State St., Erie,	Retail,	Jan. 1,	Dec. 31.
	FAYETTE COUNTY.			
1220	R. L. Weller, Main St., Belle Vernon,	Retail,	Jan. 1,	Dec. 31.
1278	O. H. Shoemaker, 230 W. Pittsburg St., Connellsville.	Retail,	Jan. 1,	Dec. 31.
1279	O. H. Shoemaker, 9 Morgantown St., Uniontown,	Retail,	Jan. 1,	Dec. 31.
1287	McGee & Co., 2 Woodvale St., Dunbar,	Retail,	Jan. 1,	Dec. 31.
1288	H. P. Smith, Railroad St., Dunbar,	Retail,	Jan. 1,	Dec. 31.
1331	C. H. Gorley, 64 W. Main St., Uniontown,	Hotel,	Mar. 1,	Dec. 31.
1335	C. H. Gorley, 16 E. Main St., Uniontown,	Restau't,	Apr. 1,	Dec. 31.
	INDIANA COUNTY.			
1313	C. H. Moore, 739 Philadelphia St., Indiana,	Hotel,	Feb. 1,	Dec. 31.
	LAWRENCE COUNTY.			
1170	C. E. Thomas, 12 S. Mill St., New Castle,	Retail,	Jan. 1,	Dec. 31.
1171	C. E. Thomas, 20 S. Mill St., New Castle,	Retail,	Jan. 1,	Dec. 31.
1230	E. O'Brein & Son, 382 W. Washington St., New Castle.	Retail,	Jan. 1,	Dec. 31.
1260	W. J. Hartzel, 8 S. Jefferson St., New Castle,	Retail,	Jan. 1,	Dec. 31.

Number.	Name and Address.	Kind.	Date Issued.	Expires.
1261	H. R. Houston, 12 E. Long Av., New Castle,	Retail, ...	Jan. 1,....	Dec. 31.
1262	J. W. Neff & Co., 399 S. Mill St., New Castle,	Retail, ...	Jan. 1,....	Dec. 31.
1263	Major & McCready, Main St., Wampum,	Retail, ...	Jan. 1,....	Dec. 31.
1272	J. Lee Cooper, 4 E. Long Av., New Castle,	Retail, ...	Jan. 1,....	Dec. 31.
1299	Gillespie & Kennedy, 14 S .Mill St., New Castle,	Retail, ...	Jan. 1,....	Dec. 31.
1306	J. W. Spencer, 82 Pittsburg St., New Castle,	Retail, ...	Jan. 1,....	Dec. 31.
1314	L. E. Phillis, 987 Lawrence St., Ellwood City,	Retail, ...	Feb. 1,....	Dec. 31.
	LUZERNE COUNTY.			
1244	J. J. Jones, 265 E. Market St., Wilkes-Barre,	Retail, ...	Jan. 1,....	Dec. 31.
1259	Davis Brothers, 43 E. Market St., Wilkes-Barre,	Retail, ...	Jan. 1,....	Dec. 31.
1280	East India Tea Company, 59 S. Main St., Wilkes-Barre, J. F. Gellis.	Retail, ...	Jan. 1,....	Dec. 31.
	McKEAN COUNTY.			
1341	John Johnson, 16 Congress St., Bradford,	Retail, ...	June 1,....	Dec. 31.
	MERCER COUNTY.			
1266	Gross & Gross, 201 Spearman St., S. Sharon,	Retail, ...	Jan. 1,....	Dec. 31.
1246	Bon Ton Restaurant, 227 W. State St., Sharon, M. Hirsh, Prop.	Restau't,	Jan. 1,....	Dec. 31.
1309	Henry Baldwin & Thos Brady, 12 Sharpville St., Sharon. Transferred March 4, 1902, to 100 N. Water St., Sharon.	Retail, ...	Jan. 1,....	Dec. 31.
1320	J. Henri Hoelzel, 323 E. State St., Sharon,	Retail, ...	Feb. 1,....	Dec. 31.
1327	J. J. Nolan, 201 Dorr St., Sharon,	Retail, ...	Feb. 1,....	Dec. 31.
	PHILADELPHIA COUNTY.			
1315	J. M. Sullivan, 419 E. Girard Av., Philadelphia, Girard Butter Company.	Retail, ...	Jan. 1,....	Dec. 31.
	POTTER COUNTY.			
1340	C. H. Rexford & Co., Cross Fork, Pa.,	Brdg. Hse.	Apr. 1,....	Dec. 31.
	VENANGO COUNTY.			
1264	Kugh & Steck, 224 Seneca St., Oil City, J. T. Kuhn & F. W. Steck.	Retail, ...	Jan. 1,....	Dec. 31.
	WASHINGTON COUNTY.			
1159	Geo. S. Daugherty & Co., Pike St., Cannonsburg,...	Retail, ...	Jan. 1,....	Dec. 31.
1167	Washington Produce House, 233 W. Chestnut St., Washington, W. G. Nease.	Retail, ...	Jan. 1,....	Dec. 31.
1168	Washington Produce House, 116 S. Main St., Washington, W. G. Nease.	Retail, ...	Jan. 1,....	Dec. 31.
1295	L. O. Swank, 536 Fallowfield Av., Charleroi,	Retail, ...	Jan. 1,....	Dec. 31.
1308	Chas. Gordon & Thos. Brady, 142 W. Chestnut St., Washington.	Retail, ...	Jan. 1,....	Dec. 31.
1319	J. A. Keeney, 18 Main St., Monongahela,	Retail, ...	Feb. 1,....	Dec. 31.
1328	Wm. Mossburg, near P. & L. E. R. R. Station, Monongahela.	Retail, ...	Feb. 1,....	Dec. 31.
1339	Williams & Kessler, Lincoln Av., McDonald,	Retail, ...	May 1,....	Dec. 31.

Number.	Name and Address.	Kind.	Date Issued.	Expires.
	WESTMORELAND COUNTY.			
1166	Shuster Brothers, 389-391 Shoomaker Av., Monnessen, A. N. & J. B. Shuster.	Retail, ...	Jan. 1,....	Dec. 31.
1172	R. H. Crawford, 225 Main St., Latrobe, ...	Retail, ...	Jan. 1,....	Dec. 31.
1236	John Kritchgan, 217 Pittsburg St., Scottdale, ...	Retail, ...	Jan. 1,....	Dec. 31.
1238	William Pascoe, 404 9th St., New Kensington, ...	Retail, ...	Jan. 1,....	Dec. 31.
1253	M. L. Sheehan, 121 S. Main St., Greensburg. This license transferred April 30, 1902, to W. Sprague,	Retail, ...	Jan. 1,....	Dec. 31.
1289	Thomas Mulholland, 625 Clay Av., Jeannette, ...	Retail, ...	Jan. 1,....	Dec. 31.
	YORK COUNTY.			
1247	George Campbell, "The Coloniel Hotel," York, ...	Hotel, ...	Jan. 1,....	Dec. 31.

LIST OF RENOVATED BUTTER LICENSES ISSUED FROM JANUARY 1, TO JUNE 30, 1902.

	SOMERSET COUNTY.			
3	The Union Creamery Company, Somerset Pa., E. M. Love, Secretary and Treasurer.	Manuf'g, .	Apr. 1,....	Dec. 31.

PART II.

GIVING A LIST

OF

ANALYSES OF SAMPLES OF FOOD,

MADE BY THE

DAIRY AND FOOD DIVISION

OF THE

DEPARTMENT OF AGRICULTURE,

FROM

JANUARY 1, 1902, TO JUNE 30, 1902.

ARRANGED BY MONTHS.

DAIRY AND FOOD DIVISON, TABULATED STATEMENT OF

Butter Analyses, November, 1901,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. 785, ...	P. 785, ...	S. B. Varga, ...	147 Frankstown Av., Pittsburg,.
H. L. B. 229,	H. L. B. 229,	H. C. Schwartz, ...	97-101 Grant St., Millvale, ...

Butter Analyses, November, 1901,

L. 355, ...	B. 533, ...	Jos. Gelb, ...	1235 South St., Philadelphia, ...

Butter Analyses, December, 1901,

W. A. H. 24,	W. A. H. 24,	Dominicko Cerare, ...	Millwood Shaft, ...
W .A. H. 25,	W. A. H. 25,	C. M. Williams, ...	Latrobe, ...
H. L. B. 242,	H. L. B. 242,	Jersey Butter Co., ...	142 W. Chestnut St., Washington.

Butter Analyses, December, 1901,

2, ...	2406, ...	Kreamer & Van Ormer, ...	Harrisburg, ...

Butter Analyses, December, 1901,

68, ...	103, ...	J. W. & F. E. Grou (Oil City Produce Co.).	112 State St., Oil City, ...
69, ...	104, ...	Frank W. Steck, ...	224 Seneca St., Oil City, ...

ANALYSES OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter, ...	Nov. 22, 1901, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	Nov. 11, 1901, ...	Apparently a mixture.

F. A. Genth Chemist.

Butter, ...	Nov. 8, 1901, ...	Artificially colored yellow, oleomargarine.

F. T. Aschman, Chemist.

Butter, ...	Dec. 27, 1901, ...	Oleomargarine, colored to imitate butter.
Butter, ...	Dec. 28, 1901, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	Dec. 6, 1901, ...	Oleomargarine, colored in imitation of yellow butter.

C. B. Cochran, Chemist.

Butter, ...	Dec. 28, 1901, ...	No adulteration.

McTaggart, Chemist.

Oleomargarine, ...	Dec. 28 ,1901, ...	This sample is uncolored oleomargarine.
Oleomargarine, ...	Dec. 28 ,1901, ...	This sample is uncolored oleomargarine.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses, December, 1901,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
134,	331,	H. B. Sweet,	106 Penn Av., Scranton,

Butter Analyses, January, 1902,

W. 389,	W. 389,	Marshall Cash Grocery,	822 Federal St., Allegheny,
W. 390,	W. 390,	E. J. Bryan,	509 Locust St., McKeesport,
Hh. B. 252,	Hh. B. 252,	Gus. Kant,	916-918 Walnut St., McKeesport,
P. 792,	P. 792,	G. F. Young,	3517 Fleming Av., Allegheny,
W. A. H. 26,	W. A. H. 26,	W. J. Hartzell,	New Castle,
W. A. H. 27,	W .A. H. 27,	Western Dairy Butter Co.,	New Castle,
W. A. H. 28,	W. A. H. 28,	C. V. Thomas,	20 South Mill St., New Castle,
W. A. H. 29,	W. A. H. 29,	C. E. Thomas,	12 South Mill St., New Castle,
W. A. H. 30,	W. A. H. 30,	J. J. Miller,	179 Mill St., New Castle,
W. A. H. 31,	W. A. H. 31,	J. W. Spencer & Co.,	New Castle,
W. A. H. 32,	W. A. H. 32,	H. R. Huston,	New Castle,
W. A. H. 34,	W. A. H. 34,	Thomas Augustine,	New Castle,
W. A. H. 36,	W. A. H. 36,	C. E. Thomas,	12 South Mill St., New Castle,
W. A. H. 37,	W .A. H. 37,	Western Dairy Butter Co. (Chas. Gillespie).	New Castle,
W. A. H. 38,	W. A. H. 38,	Joseph McFerron,	Beaver Falls,
W. A. H. 39,	W. A. H. 39,	J. E. Ewing,	Beaver Falls,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Albert H. Wells, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Oleo,	Dec. 30, 1901,	Oleomargarine, artificially colored.

F. T. Aschman, Chemist.

Butter,	Jan. 3, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 7, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 7, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 9, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 9, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 9, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 9, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 9, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 10, 1902,	Oleomargarine, colored in imitation of yellow butter.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
W. A. H. 42,	W. A. H. 42,	J. W. Vandervort,	Rochester,
W. A. H. 47,	W. A. H. 47,	M. Hirst,	Sharon,
W. A. H. 46,	W. A. H. 46,	Henri Hoelzel,	Sharon,
W. A. H. 48,	W. A. H. 48,	Jacob Gross,	South Sharon,
W. A. H. 49,	W. A. H. 49,	Thomas Mulholland,	Jeannette,
McG. 70,	McG. 70,	O. H. Shoemaker,	Uniontown,
McG. 71,	McG. 71,	O. H. Shoemaker,	Connellsville,
W. A. H. 50,	W. A. H. 50	G. W. Vandervort,	Rochester,
W. A. H. 52,	W. A. H. 52,	F. J. Hoefling,	Monaca,
McG. 72,	McG. 72,	Thomas Mulholland,	Jeannette,
McG. 73,	McG. 73,	Chicago Dairy Co.,	Greensburg,
McG. 74,	McG. 74,	R. H. Crawford,	Latrobe,
M. 300,	M. 300,	Wm. McMahon,	Home Hotel, Pittsburg,
McG. 75,	McG. 75,	Wm. Pasco,	New Kensington,
P. 794,	P. 794,	Hotel Lafayette,	1010 Liberty St., Pittsburg,
P. 791,	P. 791,	Frank Goralezyk,	2836 Carson St., Pittsburg,
W. A. H. 45,	W. A. H. 45,	Washington Tea Co.,	Erie,
W. A. H. 43,	W. A. H. 43,	M. L. Olds & Son,	Erie,
W. A. H. 44,	W. A. H. 44,	M. L. Olds & Son,	Erie,
M. 297,	M. 297,	Kaufmann's,	5th Av. and Smithfield St., Pittsburg.
P. 793,	P. 793,	A. Hancock,	Cor. Larimer and Mayflower Sts., Pittsburg.

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	Jan. 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 16, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 16, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 16, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 20, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 21, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 22, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 22, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 22, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 23, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 23, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 23, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 23, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 29, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 30, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Jan. 3, 1902,	Butter.
Butter,	Jan. 15, 1902,	Butter.
Butter,	Jan. 15, 1902,	Reichert number rather low for butter.
Butter,	Jan. 15, 1902,	Oleomargarine, not colored.
Butter,	Jan. 17, 1902,	Butter.
Butter,	Jan. 17, 1902,	Butter.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
M. 299,	M. 299,	Wm. McMahon,	Home Hotel, Pittsburg,
E. D. M. 301,	E. D. M. 301,	Wm. McMahon,	Home Hotel, Pittsburg,
T. 152,	T. 152,	Wm. McMahon,	Home Hotel, Pittsburg,

Butter Analyses, January, 1902,

3,	2432,	Kreamer & Van Ormer,	State St. Market, Harrisburg,
453,	2431,	Cumberland Valley Creamery,	Mechanicsburg,
1215,	2441,	Chas. E. Blakesley,	Mauch Chunk,
4,	2446,	From Office of Dairy and Food Commissioner.	
1204,	2442,	W J. Miles,	1717 Center St., Mahanoy City,
1205,	2445,	O. J. Saeger,	Lehighton,
1206,	2444,	J. A. Fenner,	Weisport,
1207,	2443,	Kreamer & Lentz,	Weisport,

Butter Analyses. January, 1902,

A. D. G. 128,	D. 445,	Bradley's Cash Grocery,	Mechanic St., Bradford,
A. D. G. 129,	D. 449,	Harry Dorman,	Club Market, Williamsport,

Butter Analyses, January, 1902,

J. M. S. 349-407h.	B. 570,	John E. Patton,	312 N. Front St., Phila.,
P. H. S. 141,	B. 571,	Wm. Jennings,	1408 S. Penn Sq., Phila.,
P. W. S. 142,	B. 572,	A. Dolds,	S. W. Cor. 9th and Cherry Sts., Phila.
J. M. S. 358, L. 424.	B. 573,	Lore Bros.,	Cor. 3d and McKean Sts., Phila.,
P. H. S. 144,	B. 575,	H. J. Schock,	40 N. Broad St., Phila.,
P. H. S. 145,	B. 576,	D. J. Mullen,	107 S. 13th St., Phila.,

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	Jan. 23, 1902,	Butter.
Butter,	Jan. 29, 1902,	Butter.
Butter,	Jan. 30, 1902,	Butter.

C. B. Cochran, Chemist.

Butter,	Jan. 11, 1902,	Tests indicate renovated butter.
Butter,	Jan. 16, 1902,	Not adulterated.
Butter,	Jan. 22, 1902,	Butter not renovated.
Butter,	Jan. 29, 1902,	This sample is butter; probably not renovated.
Butter,	Jan. 7, 1902,	Renovated butter.
Butter,	Jan. 9, 1902,	Renovated butter.
Butter,	Jan. 9, 1902,	Renovated butter.
Butter,	Jan. 9, 1902,	Renovated butter.

Wm. Frear, Chemist.

Creamery butter,	Jan. 15, 1902,	Is renovated butter.
Butter,	Jan. 25, 1902,	"Oleo" colored like yellow butter.

F. A. Genth, Chemist.

Butter,	Jan. 8, 1902,	Pure.
Butter,	Jan. 17, 1902,	Pure.
Butter,	Jan. 17, 1902,	A sample of stale butter.
Butter,	Jan. 17, 1902,	Pure but stale.
Butter,	Jan. 21, 1902,	Pure.
Butter,	Jan. 23, 1902,	Pure.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. H. S 147,	B. 577,	Paul J. Buettner,	828 Vine St., Philadelphia,
H. 406,	B. 569,	A. H. Van Wert,	419 E. Girard Av.,
P. H. S. 143,	B. 574,	Carl Dannhauser,	S. W. Cor. 6th and Callowhill Sts., Phila.
439, J. M. S. 373.	B. 578,	A. P. Cline, University Dining Hall.	S. W. Cor. 36th and Spruce Sts., Phila.
P. H. S. 150,	B. 579,	Carl Dannhauser,	S. W. Cor. 6th and Callowhill Sts., Phila.

Butter Analyses, January, 1902,

72,	107,		Warren,
73,	108,	Standard Market,	Warren,
70,	105,	C. J. Wright,	20 Thirteenth St., Franklin,
71,	105,	J. F. Doubles,	Reynoldsville,

Butter Analyses, January, 1902,

163,	332,	J. J. Higgins,	Carbondale,

Butter Analyses, February, 1902,

F. 472,	F. 472,	John Smittel,	Altoona, Pa.,
F. 154,	F. 154,	Adam Weitzel,	99 and 101 Washington Av., Pittsburg.
W. A. H. 55,	W. A. H. 55,	H. R. Huston,	New Castle,
W. A. H. 56,	W. A. H .56,	J. L. Cooper,	New Castle,
W. A. H. 57,	W. A. H. 57,	J. J. Nolan,	Sharon,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	Jan. 25, 1902,	Pure.
Butter,	Jan. 3, 1902,	Yellow oleomargarine.
Butter,	Jan. 18, 1902,	Artificially colored yellow oleomargarine.
Butter,	Jan. 25, 1902,	Artificially colored yellow oleomargarine.
Butter,	Jan. 29, 1902,	Artificially colored yellow oleomargarine.

McTaggart, Chemist.

Creamery butter,	Jan. 31, 1902,	Sample is butter, not renovated, not colored.
Creamery butter,	Jan. 31, 1902,	Sample is butter, not renovated; is colored.
Butterine,	Jan. 4, 1902,	This sample is uncolored oleomargarine.
Oleomargarine,	Jan. 18, 1902,	This sample is artificially colored oleomargarine.

Albert H. Wells, Chemist.

Butter,	Jan. 11, 1902,	Renovated butter.

F. T. Aschman, Chemist.

Butter,	Feb. 1, 1902,	Sample is renovated butter.
Butter,	Feb. 6, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 6, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 6, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 7, 1902,	Oleomargarine, colored in imitation of yellow butter.

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
W. A. H. 58,	W. A. H. 58,	Frank Gross,	Sharon,
W. A. H. 59,	W. A. H. 59,	Henry Baldwin,	Sharon,
W. A. H. 61,	W. A. H. 61,	Joseph McFerron,	Beaver Falls,
W. A. H. 62,	W. A. H. 62,	Ewing Bros.,	Beaver Falls,
F. 158,	F. 158,	H. M. Cambridge,	600 Herron Av., Pittsburg,
F. 473,	F. 473,	Geo. Schmittle,	Altoona,
W. A. H. 54,	W. A. H. 54,	L. E. Philips,	Elwood City,
M. 302,	M. 302,	E. T. Critchfield,	Main St., Rockwood,

Butter Analyses, February, 1902,

1231,	2474,	A. W. Loder & Sons,	East Stroudsburg,
1228,	2482,	J. Shotwell & Son,	East Stroudsburg,
1233,	2477,	Miller Bros.,	East Stroudsburg,
1236,	2476,	W. S. Express Office,	Stroudsburg,
5,	2457,	Atlantic and Pacific Tea Co.,	Harrisburg,
2460,	2460,	Fisher Bros.,	Rolfe,
2459,	2459,	C. A. Stoner,	Gettysburg,
454,	2468,	Chas. D. Leedy,	Cor. 3d and Chestnut Sts., Harrisburg.
1232,	2475,	A. W. Loder & Sons,	East Stroudsburg,
1234,	2478,	Miller Bros.,	Stroudsburg,
1237,	2483,	J. S. Strunk,	Bangor,

Butter Analyses, February, 1902,

A. D. G. 131,	D. 452,	N. A. Nusbaum,	67 Mechanic St., Bradford,
A. D. G. 130,	D. 451,	Bradley's Cash Grocery,	Mechanic St., Bradford,
132-52,	D. 450,	John Johnson,	Bradford,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	Feb. 7, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 7, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 26, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 26, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 26, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Feb. 1, 1902,	Apparently renovated butter.
Butter,	Feb. 6, 1902,	Butter.
Butter,	Feb. 22, 1902,	Butter.

C. B. Cochran, Chemist.

Butter,	Feb. 25, 1902,	Renovated butter.
Butter,	Feb. 25, 1902,	Renovated butter.
Butter,	Feb. 26, 1902,	Renovated butter.
Butter,	Feb. 26, 1902,	Renovated butter.
Butter,	Feb. 3, 1902,	No evidence of adulteration.
Butter,		Oleomargarine.
Butter,		Not adulterated.
Butter,	Feb. 13, 1902,	Renovated butter.
Butter,	Feb. 25, 1902,	Not adulterated.
Butter,	Feb. 26, 1902,	Pure butter.
Butter,	Feb. 27, 1902,	Probably renovated butter.

Wm. Frear, Chemist.

Pure butter,	Feb. 21, 1902,	Renovated butter.
Butter,	Feb. 21, 1902,	Renovated butter.
Butter,	Feb. 25, 1902,	Is "oleo" colored by azo-dye, like yellow butter.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses, February, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. H. S. 157,	B. 582,	Walt Gingrich,	5 South 3d St., Philadelphia,
L. 448, J. M. S. 382.	B. 584,	Carl Dannhauser,	S. W. Cor. 6th and Callowhill Sts., Philadelphia.
L. 449, J. M. S. 383.	B. 585,	J. Buschel,	739 S .2d St., Philadelphia,
P. H. S. 152,	B. 580,	J. Slade,	159 Lehigh Av., Philadelphia,
P. H. S. 156,	B. 581,	W. A. Couch,	1518 Market St., Philadelphia,
446, L. J. M. S. 380.	B. 583,	John Eagleson,	2849 Germantown Av., Phila.,
P. H. S. 159,	B. 587,	Jos. Bounds,	17 S. 13th St., Philadelphia,
P. H S 158,	B. 586,	Fred. Williams,	305 S. 2d St., Philadelphia,
P. H. S. 160,	B. 588,	A. C. Deitrich,	722 Sansom St., Philadelphia,
P. H. S. 161,	B. 589,	T. Murphy,	1425 Filbert St., Philadelphia,

Butter Analyses, February, 1902,

75,	110,	Alex. Shaw,	Warren,
74,	109,	P. E. Fehlman,	Warren,

Butter Analyses, February, 1902,

166,	336,	Charles F. Carman,	Laceyville,
169,	338,	Carlin & Gregory,	Laceyville,
170,	339,	Carlin & Gregory,	Laceyville,
167,	337,	C. F. Carman,	Laceyville,

Butter Analyses, April, 1902,

McG. 76,	McG. 76,	Fred. Meyers,	Kittanning,
T. 160,	T. 160,	Sheehan & Cavanaugh,	Cor. 3d Av. and Market St., Pittsburg.
W. 391,	W. 391,	Fasnight & Auth,	206 Main St., W. E., Pittsburg,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter, ...	Feb. 15, 1902, ...	Renovated butter.
Butter, ...	Feb. 17, 1902, ...	Artificially colored yellow oleomargarine.
Butter, ...	Feb. 25, 1902, ...	So called "sweet butter" loaded with water.
Butter, ...	Feb. 8, 1902, ...	Pure.
Butter, ...	Feb. 15, 1902, ...	Pure.
Butter, ...	Feb. 15, 1902, ...	Pure.
Butter, ...	Feb. 25, 1902, ...	Pure.
Butter, ...	Feb. 25, 1902, ...	Pure.
Butter, ...	Feb. 26, 1902, ...	Pure.
Butter, ...	Feb. 27, 1902, ...	Pure.

McTaggart, Chemist.

Creamery butter, ...	Feb. 1, 1902, ...	Sample is butter, not renovated, is colored.
Creamery butter, ...	Feb. 1, 1902, ...	Sample is butter, not renovated, not colored.

Albert H. Wells, Chemist.

Butter, ...	Feb. 26, 1902, ...	Not genuine butter.
Butter, ...	Feb. 26, 1902, ...	Satisfactory.
Butter, ...	Feb. 26, 1902, ...	Satisfactory.
Butter, ...	Feb. 26, 1902, ...	Sample satisfactory.

F. T. Aschman, Chemist.

Butter, ...	Mar. 4, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	Mar. 4, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	Mar. 4, 1902, ...	Oleomargarine, colored in imitation of yellow butter.

AIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
T. 165,	T. 165,	John Houston,	178 Allegheny Market, Allegheny.
P. 795,	P. 795,	J. L. Brown,	613 Homewood Av., Pittsburg,
P. 796,	P. 796,	W. C. Staving,	204 Allegheny Market, Allegheny.
W. 392,	W. 392,	Frank J. Wesley,	4011 Butler St., Pittsburg,
W. A. H. 74,	W. A. H. 74,	E. Q. Brien & Son,	New Castle,
T. 164,	T. 164,	J. R. Martin,	201-202 Allegheny Market, Allegheny.
W. 394,	W. 394,	D. W. Campbell,	3625 Butler St., Pittsburg,
M. 305,	M. 305,	L. A. Kelly,	5205 Butler St., Pittsburg,
W. 395,	W. 395,	Ellen Moreland,	5139 Butler St., Pittsburg,
P. 797,	P. 797,	W. G. Kregar,	228 Brushton Av., Pittsburg,
W. 397,	W. 397,	J. J. Wise,	811 5th Av., McKeesport,
T. 168,	T. 168,	H. C. Schwartz,	99 or 411 Grant Av., Bennett,
M. 309,	M. 309,	Minton & McCreary,	Hotel Siegel, Washington,
P. 798,	P. 798,	G. A. Schmitt,	805 Penn Av., Wilkinsburg,
W. 400,	W. 400,	H. A. Wilcox & H. A. Wehrle,	4810 Liberty Av., Pittsburg,
W. 402,	W. 402,	S. G. McCutcheon,	819 Wood St., Wilkinsburg,
W. 403,	W. 403,	Albert Burgess,	1901 Center Av., Pittsburg,
M. 313,	M. 313,	N. Huber,	2158 Wylie Av., Pittsburg,
W. 406,	W. 406,	B. M. Quinn,	845 Braddock Av., Brad-dock,

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	Mar. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 8, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 11, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 12, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 12, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 13, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 13, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 14, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 14, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 15, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 18, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 19, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 21, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 24, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 24, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 24, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 25, 1902,	Oleomargarine, colored in imitation of yellow butter.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
M. 315,	M. 315,	A. J. McQuiggan,	552 and 552½ Braddock Av., Braddock.
M. 317,	M. 317,	H. J. Ehrhardt,	135 Market House, Allegheny,
T. 174,	T. 174,	John G. Messner,	415 Market St., Pittsburg,
P. 800,	P. 800,	Buckeye Butter Co.,	E. E. Market House, Pittsburg,
W. 408,	W. 408,	R. Lowenstine,	74 Frankstown Av., Pittsburg,
M. 318,	M. 318,	Paul A. Hughes,	564 Homewood Av., Pittsburg,
M. 319,	M. 319,	A. L. Ritchey,	436 Market St., Pittsburg,
T. 175,	T. 175,	Harper & Wynne,	1734 5th Av., Pittsburg,
W. 410,	W. 410,	S. G. Shoop,	1201 Federal St., Allegheny,
W. 409,	W. 409,	S. B. Charters,	3d Av. and Grant St., Pittsburg,
M. 320,	M. 320,	W. M. Swindler,	434 Market St., Pittsburg,
M. 321,	M. 321,	Sheehan & Cavanaugh,	313 Market St., Pittsburg,
C. 11,	C. 11,	C. O. Williams,	150 W. 26th St., Erie,
W. 398,	W. 398,	John Keil, Jr.,	4020 Butler St., Pittsburg,
T. 172,	T. 172,	George Ritter,	307 Main St., Sharpsburg,
P. 800,	P. 800,	Harry Cupps,	54 Chartiers Av., McKees Rocks,
P. 802,	P. 802,	Highland Supply Co.,	64 Frankstown Av., Pittsburg,

Butter Analyses, March, 1902,

1244,	2485,	F. J. Hettinger,	Lehighton,
455,	2484,	Chas. D. Leidy,	Cor. 3d and Chestnut Sts., Harrisburg.
456,	2489,	S. N. Weaver,	Columbia, Pa.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	Mar. 25, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 26, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 27, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 27, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 27, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 27, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 27, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 28, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 28, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 28, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 28, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 28, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	Mar. 11, 1902,	Butter.
Butter,	Mar. 15, 1902,	Butter.
Butter,	Mar. 21, 1902,	Butter in spite of stamp.
Butter,	Mar. 26, 1902,	Butter.
Butter,	Mar. 28, 1902,	Oleomargarine, practically colorless.

C. B. Cochran, Chemist.

Butter,	Mar. 12, 1902,	Renovated butter.
Butter,	Mar. 4, 1902,	Renovated butter.
Butter,	Mar. 19, 1902,	Probably renovated, but am not willing to so testify.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
457,	2490,	Maurice Eby,	Cor. 5th and Market Sts., Harrisburg.
2502,	2502,	Claude Brannan,	960 N. 11th St., Reading,
108,	2505,	Pennsylvania Produce Co.,	Reading,

Butter Analyses, March, 1902,

133,	D. 459,	McEvory Bros.,	Bradford,

Butter Analyses, March, 1902,

L. 457, J. M. S. 391, P. H. S. 162.	B. 590,	A. P. Cline,	University Dining Hall, 361 Spruce St., Phila.
458 L. J. M., S. 392.	B. 591,	Louis Scheurer,	730 South 2d St., Phila.,
459 L., J. M. S. 393.	B. 592,	U. S. Naval Home,	Gray's Ferry Road, Phila.,
474 L., J. M. S. 406.	B. 596,	Girard Butter Co.,	2239 Frankford Av., Phila.,
486 L., J. M. S. 418.	B. 598,	Girard Butter Co.,	2239 Frankford 9v., Phila.,
L. 487, J. M. S. 419.	B. 599,	Girard Butter Co.,	419 E. Girard Av., Phila.,
L. 504,	B. 600,	J. Buschel,	739 South 2d St., Phila.,
P. H. S. 163,	B. 593,	Chas. Ryers,	109 E. Girard Av., Phila.,
466 L.	B. 594,	A. H. Bouser,	719 Terminal Market, Phila.,
481 L., J. M. S. 413.	B. 597,	Johnson, Warren & Co.,	1017 Market St., Phila.,

Butter Analyses, March, 1902,

171,	340,	A. W. Lyons,	Montrose,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	Mar. 20, 1902,	Renovated.
Butter,	Mar. 26, 1902,	Not adulterated.
Butter,	Mar. 26, 1902,	Not adulterated.

Wm. Frear, Chemist.

Butter,	Mar. 21, 1902,	Renovated.

F. A. Genth, Chemist.

Butter,	Mar. 3, 1902,	It was yellow oleomargarine, artificially colored.
Butter,	Mar. 6, 1902,	Renovated butter.
Butter,	Mar. 7, 1902,	Artificially colored yellow oleomargarine.
Butter,	Mar. 14, 1902,	Artificially colored yellow oleomargarine.
Butter,	Mar. 21, 1902,	Artificially colored yellow oleomargarine.
Butter,	Mar. 21, 1902,	Artificially colored yellow oleomargarine.
Butter,	Mar. 26, 1902,	Rancid tallowy butter, unfit for use as butter.
Butter,	Mar. 8, 1902,	Pure.
Butter,	Mar. 12, 1902,	Pure.
Butter,	Mar. 20, 1902,	Pure.

Albert H. Wells, Chemist.

Butter,	Mar. 12, 1902,	Genuine butter.

Butter Analyses, April, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
McG. 77, ...	McG. 77, ...	W. A. Sprange, ...	Greensburg, ...
H. 75, ...	H. 75, ...	John Kritchgan, ...	Scottdale, ...
McG. 80, ...	McG. 80, ...	R. H. Crawford, ...	Latrobe, ...
McG. 78, ...	McG. 78, ...	O. H. Shoemaker, ...	Uniontown, ...
McG. 79, ...	McG. 79, ...	O. H. Shoemaker, ...	Connellsville, ...
W. 412, ...	W. 412, ...	H. Watson, ...	196 Main St., W. E., Pittsburg,
W. 413, ...	W. 413, ...	M. J. Leonard, ...	86 Main St., Sharpsburg, ...
W. 415, ...	W. 415, ...	J. D. Wilson, ...	2102 Carson St., S. S., Pittsburg,
W. 414, ...	W. 414, ...	A. Braun, ...	Stand 193 Allegheny Market, Allegheny.
M. 322, ...	M. 322, ...	T. Finkel, ...	2108 Carson St., S. S., Pittsburg,
W. 416, ...	W. 416, ...	Frank L. Andrews, ...	4828 Penn Av., Pittsburg, ...
W. 417, ...	W. 417, ...	Adam Weitzel, ...	86 Washington Av., S. S., Pittsburg.
W. 418, ...	W. 418, ...	W. J. Miller, ...	249 Butler St., Etna, ...
W. 419, ...	W. 419, ...	Elgin Supply Co., ...	2136 5th Av., Pittsburg, ...
W. 420, ...	W. 420, ...	J. J. Anthony, ...	121 Ohio St., Allegheny, ...
H. 77, ...	H. 77, ...	R. J. Waller, ...	Belle Vernon, ...
H. 78, ...	H. 78, ...	Shuster Bros., ...	Monessen, ...
C. 13, ...	C. 13, ...	J. J. Nolan, ...	South Sharon, ...
C. 14, ...	C. 14, ...	Henry Hoelzel, ...	Sharon, ...

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	April 1, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 2, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 2, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 2, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 2, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 2, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 2, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 3, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 3, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 3, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 4, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 4, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 5, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 5, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 7, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 10, 1902,	Oleomargarine, colored in imitation of yellow butter.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
C. 15, ...	C. 15, ...	Bon-Ton Restauranut, ...	Sharon, ...
C. 16, ...	C. 16, ...	John J. Heimbacher, ...	South Sharon, ...
P. 803, ...	P. 803, ...	Smith Hosteller, ...	3d St., Pitcairn, ...
P. 804, ...	P. 804, ...	Chris Hassler, ...	Railroad St., Wilkinsburg, ...
F. 497, ...	F. 497, ...	J. C. Beers, ...	Blair Station, ...
M. 324, ...	M. 324, ...	Geo. W. Ruppert, ...	919 East St., Allegheny, ...
P. 805, ...	P. 805, ...	C. L. Morrow, ...	Turtle Creek, ...
W. 423, ...	W. 423, ...	F. E. Richards, ...	Stand 87 Allegheny Market, Allegheny.
W. 424, ...	W. 424, ...	Wm. Mossburg, ...	Carleton, ...
M. 328, ...	M. 328, ...	J. A. Keeney, ...	Monongahela, ...
F. 499, ...	F. 499, ...	B. Reese & W. Roden, ...	Johnstown, ...
F. 500, ...	F. 500, ...	Caulfield & Coyle, ...	Johnstown, ...

Butter Analyses, April, 1902,

H. 79, ...	H. 79, ...	Grand Hotel, ...	Beaver Falls, ...
M. 329, ...	M. 329, ...	Mrs. Mary Smith, ...	2230 5th Av., Pittsburg, ...
H. 80, ...	H. 80, ...	Park Hotel, ...	New Brighton, ...
H. 81, ...	H. 81, ...	Clyde Hotel, ...	New Brighton, ...
P. 806, ...	P. 806, ...	H. L. Woods, ...	419 Mill St., Coraopolis, ...

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	April 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 10, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 11, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 11, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 11, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 12, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 12, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 14, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 14, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 15, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 15, 1902,	Oleomargarine, colored in imitation of yellow butter.

F. T. Aschman, Chemist.

Butter,	April 16, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 16, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 17, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 17, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	April 17, 1902,	Oleomargarine, colored in imitation of yellow butter.

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. 807,	P. 087,	L. Greenwald,	42 Washington St., S. S., Pittsburg.
C. 18,	C. 18,	Senson & Beals,	Meadville,
P. 808,	P. 808,	Henry Kruse,	Etna St. and Evergreen Av., Millvale.
W. 427,	W. 427,	P. M. Corrigan,	1905 Penn Av., Pittsburg,
M. 330,	M. 330,	Stenger Bros.,	921 Wylie Av., Pittsburg,
W. 429,	W. 429,	Chas. G. Hoover,	Stand 93, Allegheny Market, Allegheny.
W. 430,	W. 430,		4802 2d Av., Pittsburg,
M. 331,	M. 331,	Greenfield Butter Co.,	1358 2d Av., Pittsburg,
P. 809,	P. 809,	John Foy,	574 Grant Boulevard, Pittsburg,
P. 810,	P. 810,	Flynn Tea Co.,	635 33d St., Pittsburg,
P. 811,	P. 811,	Mrs. Mary A. Guttendorf,	2624 Carson St., S. S., Pittsburg,
H. 82,	H. 82,	J. McFerron,	Beaver Falls,
H. 83,	H. 83,	Ewing Bros.,	Beaver Falls,
H. 84,	H. 84,	W. W. McCandless,	Beaver Falls,
W. 431,	W. 431,	John A. Schouder,	Stand 14, Pittsburg Market, Pittsburg.
W. 434,	W. 434,	James Reid,	205 8th Av., Homestead,
W. 421,	W. 421,	H. Henke,	Washington and Webster Avs., Pittsburg.
F. 498,	F. 498,	A. F. Harper,	Blair Station,
W. 422,	W. 422,	P. H. Butler,	866 Ohio St., Allegheny,
W. 426,	W. 426,	B. Kripp,	51 5th Av., Pittsburg,
W. 428,	W. 428,	F. G. Bischoff,	315 W. Braddock Av., Rankin,
W. 432,	W. 432,	Wm. McMahon,	Home Hotel, Duquesne Way, Pittsburg.

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.
—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter, ...	April 17, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 18, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 18, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 18, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 18, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 19, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 22, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 22, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 23, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 23, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 24, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 25, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 25, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 25, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 26, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 29, 1902, ...	Oleomargarine, colored in imitation of yellow butter.
Butter, ...	April 10, 1902, ...	Butter.
Butter, ...	April 11, 1902, ...	Pure butter.
Butter, ...	April 11, 1902, ...	Butter.
Butter, ...	April 15, 1902, ...	Butter.
Butter, ...	April 19, 1902, ...	Oleomargarine, pale colored.
Butter, ...	April 28, 1902, ...	Butter.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses, April, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
1247,	2508,	Geo. M. Hunsinger,	Tremont,
1248,	2512,	D. H. Snyder & Co.,	Sunbury,
459,	2520,	S. H. Weaver,	Columbia,

Butter Analyses, April, 1902,

135,	D. 463,	Havenor Bros.,	Port Allegany,
F. 495,	D. 460,	John Benson,	Houtzdale,
259,	D. 467,	East India Tea Co., J. T. Gillis, prop.	59 S. Main St., Wilkes-Barre,
258,	D. 466,	Davis Bros.,	163 E. Market St., Wilkes-Barre,
257,	D. 465,	J. J. Jones,	265 E. Market St., Wilkes-Barre,
260,	D. 468,	Royal Tea Co.,	S. Main St., Pittston,
261,	D. 469,	W. J. Marvel,	142-4 Penna. Av., Scranton,
262,	D. 470,	H. B. Sweet,	106 Penn Av., Scranton,
F. 496,	D. 461,	Geo. Richards,	Philipsburg,
460,	D. 464,	John Peters,	Williamsport,

Butter Analyses, April, 1902,

L. 505, J. M. S. 436.	B. 601,	L. Taylor,	58th and Market Sts., Phila.,
506 L., J. M. S. 437.	B. 602,	H. Dumas,	56th and Arch Sts., Phila.,
507 L.,	B. 603,	L. Taylor,	N. W. Cor. 58th and Market Sts., Phila.
514 L., J. M. S. 445.	B. 605,	A. H. VanWert,	419 E. Girard Av., Phila.,
513 L., J. M. S. 444.	B. 604,	A. H. VanWert,	419 E. Girard Av., Phila.,
L. 512, J. M. S. 443.	B. 606,	Girard Butter Co.,	2239 Frankford Av., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	April 2, 1902,	Renovated butter.
Butter,	April 9, 1902,	Renovated.
Butter,	April 8, 1902,	Renovated butter.

Wm. Frear, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	April 4, 1902,	Is renovated butter.
Country print butter,	April 4, 1902,	Is renovated butter.
"Butter Creamery,"..	April 9, 1902,	Is "oleo" colored like yellow butter by azo-dye.
Oleomargarine,	April 9, 1902,	Is "oleo'" colored like yellow butter by azo-dye.
Oleomargarine,	April 9, 1902,	Is "oleo'" colored like yellow butter by azo-dye.
Butterine,	April 10, 1902,	Is "oleo'" colored like yellow butter by azo-dye.
Oleomargarine sold as butter.	April 12, 1902,	Renovated butter.
Butter,	April 14, 1902,	Oleo, colored like yellow butter by azo-dye.
Butter,	April 5, 1902,	Not proven to be renovated butter.
Creamery butter,	April 9, 1902,	Is renovated butter.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	April 1, 1902,	Artificially colored yellow oleomargarine.
Butter,	April 1, 1902,	Artificially colored yellow oleomargarine.
Butter,	April 3, 1902,	Artificially colored oleomargarine.
Butter,	April 5, 1902,	Artificially colored yellow oleomargarine.
Butter,	April 5, 1902,	Oleomargarine, with traces of coloring mater.
Butter,	April 5, 1902,	Artificially colored yellow oleomargarine.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
516 L., J. M. S. 447.	B. 607,	Quaker City Grocery,	5617 Market St., Phila.,
521 L., J. M. S. 452.	B. 609,	J. E. DeCon,	Salmon and Cumberland Sts., Phila.
H. L. B. 263,	B. 616,	Nice & Schreiber,	19 and 21 S. Water St., Phila.,
P. H. S. 170,	B. 618,	S. Silberstein & F. Rosenfeld,	246 Market St., Phila.,

Butter Analyses, April, 1902,

L. 517, J. M. S. 447.	B. 608,	Thomas Hunter,	S. E. Cor. 8th and Montgomery Av., Phila.
521 L., J. M. S. 453.	B. 610,	Majestic Tea Co.,	Richmond and Neff Sts., Phila.,
522 L., J. M. S. 454.	B. 611,	Grocery Store,	1216 South St., Phila.,
524 L., J. M. S. 455.	B. 612,	Grocery Store,	1210 South St., Phila.,
J. M. S. 456, 525 L.	B. 613 (a) & (b).	Concitto Rago,	1001 Passyunk Av., Phila.,
P. H. S. 164,	B. 615,	Klineberger's Dining Room,	S. 10th St., Phila.,
P. H. S. 167,	B. 617,	Wilton's Restaurant,	353 N. 2d St., Phila.,

Butter Analyses, April, 1902,

181,	350,	Joseph Cross,	Scranton,
180,	349,	J. W. Bactosky,	Minooka,
351,	351,	Michael Jobas,	123 Broadway St., Scranton,
345,	345,		
344,	344,		
346,	346,		
347,	347,		
343,	343,		
348,	348,		

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	April 8, 1902,	Colored, yellow oleomargarine.
Butter,	April 10, 1902,	Renovated butter.
Butter,	April 25, 1902,	Renovated butter not marked.
Butter,	April 30, 1902,	Renovated butter.

F. A. Genth, Chemist.

Butter,	April 10, 1902,	Pure.
Butter,	April 10, 1902,	Pure.
Butter,	April 11, 1902,	Pure.
Butter,	April 11, 1902,	Not renovated but old.
Butter,	April 11, 1902,	Both pieces are low grade creamery butters.
Butter,	April 25, 1902,	Pure.
Butter,	April 26, 1902,	Pure.

Albert H. Wells, Chemist.

Butter,	April 26, 1902,	Oleomargarine, artificially colored.
Butter,	April 25, 1902,	Oleomargarine, artificially colored.
Butter,	April 21, 1902,	Oleomargarine, artificially colored.
Butter,	April 21, 1902,	Oleomargarine, artificially colored.
Butter,	April 21, 1902,	Oleomargarine, artificially colored.
Butter,	April 21, 1902,	Oleomargarine, artificially colored.
Butter,	April 21, 1902,	Oleomargarine, artificially colored.
Butter,	April 21, 1902,	Oleomargarine, artificially colored.
Butter,	April 21, 1902,	Butter, satisfactory.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses, May, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. 812,	P. 812,	J. S. Catherwood,	1109 Murtland Av., Pittsburg,
M. 339,	M. 339,	Wm. Wahl,	Commercial Hotel, Evans City,
P. 817,	P. 817,	Mrs. Anna Riley,	313 33d St., Pittsburg,
104 W. A. H.,	H.,	A. Cooper,	New Brighton,
103 W. A. H.,	H.,	F .A. Morrison,	New Brighton,
105 W. A. H.,	H.,	F .A. Morrison,	New Brighton,
P. 813,	P. 813,	Mrs. Maggie Fisher,	40 Bell Av., McKees Rocks,
W. 436,	W. 436,	J. A. Ehmer,	2d St., Butler,
W. A. H. 96,	W. A. H. 96,	Thomas Mulholland,	Jeannette,
P. 818,	P. 818,	Wm. Kant,	510 Locust St., McKeesport,
P. 819,	P. 819,	John Vohr,	6910 Hamilton Av., Pittsburg,

Butter Analyses, May, 1902,

464,	D. 474,	A. Etnier,	Huntingdon,
465,	D. 475,	M. L. Sumers,	5th and Penn Sts., Huntingdon,
505,	D. 481,	Caulfield & Coyle,	Johnstown,
504,	D. 480,	Benjamin Reese,	Johnstown,

Butter Analyses, May, 1902,

P. H. S. 172,	B. 619,	Cameron's Restaurant,	1211 N. 2d St., Phila.,
P. H. S. 176,	B. 621,	Rosenberger's Restaurant,	1434 Cumberland St., Phila.,
J. M. S. 479, L. 549.	B. 623,	S. B. Ellis Co.,	542 Henderson St., Jersey City, N. J.
L. 537, J. M. S. 468.	B. 620,	Robinson & Crawford,	1024-6 South St., Phila.,
546 L., J. M. S. 477.	B. 622,	St. Charles Hotel,	3d and Arch Sts., Phila.,
P. H. S. 177,	B. 624,	Twombly & Stuckey,	23 N. 11th St., Phila.,
J. M. S. 485,	B. 625,	F. C. Cleaner,	4090 Lancaster Av., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. T. Ashman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	May 2, 1902,	Butter.
Butter,	May 12, 1902,	Butter.
Butter,	May 14, 1902,	Renovated butter.
Butter,	May 22, 1902,	Butter.
Butter,	May 23, 1902,	Butter.
Creamery butter,	May 23, 1902,	Sputters in spoon.
Country butter,	May 3, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	May 5, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	May 14, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	May 22, 1902,	Oleomargarine, colored in imitation of yellow butter.
Butter,	May 23, 1902,	Oleomargarine, colored in imitation of yellow butter.

Wm. Frear, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	May 8, 1902,	Is renovated butter.
Pure butter,	May 8, 1902,	Suspicious because of crystallization, but evidence insufficient to condemn.
Butter,	May 16, 1902,	Colored "oleo," but not colored in imitation of yellow butter.
Oleomargarine,	May 16, 1902,	Oleo, colored in imitation of yellow butter, in part of "azo-dye."

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Oleomargarine,	May 2, 1902,	Artificially colored yellow oleomargarine.
Butter,	May 10, 1902,	Yellow oleomargarine.
Butter,	May 24, 1902,	Artificially colored yellow oleomargarine.
Butterine,	May 3, 1902,	Pure.
Butter,	May 15, 1902,	Pure.
Butter,	May 28, 1902,	Pure.
Butter,	May 29, 1902,	Pure.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Butter Analyses, June, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
183,	352,	John Pinko,	Scranton,
186,	356,	Fred. Hugg,	Pittston Av., Scranton,
188,	357,	Lewis Brooks,	Scranton,
184,	353,	Sam Miller,	Scranton,
187,	354,	Mellet's Market,	1127 Pittston Av., Scranton,
185,	355,		Hazleton,

Butter Analyses, May, 1902,

473,	2590,	Percy A. Cunningham,	Lewistown,

Butter Analyses, June, 1902,

573 L.,	B. 630,	David Ogden,	2417 Ridge Av., Phila.,
584 L.,	B. 638,	James J. Madden Co.,	709 Passyunk Av., Phila.,
P. H. S. 181,	B. 626,	F. Rosenberger,	1434 Cumberland St., Phila.,
L. 558, J. M. S. 487.	B. 627 (a) & (b).	S. B. Elles Co.,	Jersey Shore,
P. H. S. 183,	B. 628,	F. Dahnedo,	Warnock and Girard Avs., Phila.
506 J. M. S., 580 L.	B. 635,	Mr. Ogden,	2417 Ridge Av., Phila.,
578 L., J. M. S. 504.	B. 632,	David S. Ogden,	2417 Ridge Av., Phila.,
L. 572, J. M. S. 499.	B. 629,	Chas. Roesch & Sons,	723 Vine St., Phila.,
P. H. S. 187,	B. 631,	Jas. Madden,	610 N. 2d St., Phila.,
P. H. S. 189,	B. 633,	J. Harts,	125 S. 10th St., Phila.,
P. H. S. 191,	B. 634,	Waugh's Restaurant,	2526 Richmond St., Phila.,
581 L.	B. 636,	Kelley's Milk House,	N. E. Cor. 12th and Tree Sts., Phila.
588 L., J. M. S. 508.	B. 642,	Jas. J. Madden Co.,	709 Passyunk Av., Phila.,
589 L., J. M. S. 509.	B. 643,	Jas. J. Madden Co.,	1319 South St., Phila.,
583 L.,	B. 637,	Jas. J. Madden Co.,	1319 South St., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Albert H. Wells, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Butter,	May 1, 1902,	Oleomargarine, artificially colored.
Butter,	May 2, 1902,	Oleomargarine, artificially colored.
Butter,	May 6, 1902,	Oleomargarine, artificially colored.
Butter,	May 1, 1902,	Butter, satisfactory.
Butter,	May 2, 1902,	Butter, satisfactory.
Butter,		Butter, satisfactory.

C. B. Cochran, Chemist.

Pine creamery butter,	June 19, 1902,	Not adulterated.

F. A. Genth, Chemist.

Butter,	June 13, 1902,	Artificially colored yellow oleomargarine.
Butter,	June 27, 1902,	Pure.
Butter,	June 2, 1902,	Pure.
Butter,	June 6, 1902,	Artificially colored yellow oleomargarine.
Butterine,	June 7, 1902,	Pure.
Butter,	June 12, 1902,	Artificially colored yellow oleomargarine.
Butter,	June 18, 1902,	Artificially colored yellow oleomargarine.
Butter,	June 13, 1902,	Stale butter.
Butter,	June 14, 1902,	Pure.
Butter,	June 20, 1902,	Pure.
Butter,	June 21, 9102,	Pure.
Butter,	June 24, 1902,	Pure.
Butter,	June 25, 1902,	Colored yellow oleomargarine.
Butter,	June 25, 1902,	Artificially colored yellow oleomargarine.
Butter,	June 27, 1902,	Pure.

Butter Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
264,	380,	Russell Uhl,	24 Public Square, Wilkes-Barre,

Cheese Analyses, January, 1902,

434 L., J. M. S. 368.	A. 393,	Thomas Hunter,	19th and Market Sts., Phila.,
J. M. S. 377, L. 443.	A. 402,	Thomas Hunter,	1624 S. 10th St., Phila.,
P. H. S. 151,	A. 407,	Acme Tea Co., Thomas Hunter,	S. W. Cor. 6th and Spruce Sts., Phila.
P. H. S. 148,	A. 405,	James Bell,	531 Girard Av., Phila.,

Cheese Analyses, February, 1902,

F. 153,	F. 152,	H. C. Eibs,	40 Washington Av., S. S., Pittsburg.
M. 303,	M. 303,	W. J. Schuster,	4059 Penn Av., Pittsburg,

Cheese Analyses, June, 1902,

P. H. S. 188,	A. 546,	Acme Tea Co.,	701 Passyunk Av., Phila.,

Milk Analyses, January, 1902,

F. 464,	F. 464,	Wm. Cunningham,	Hollidaysburg,

Milk Analyses, January, 1902,

79,	2408,	G. R. Wells,	318 West 3d St., Chester,
80,	2409,	Clarence Whelan,	Lynnwood, Del Co.,
81,	2410,	George Snyder,	Chester, Del. Co.,
85,	2412,	P. Dehner,	Chester, Del. Co.,
86,	2413,	J. Evans,	Media, Del. Co.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Albert H. Wells, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Oleomargarine, ...	June 17, 1902, ...	Oleomargarine, artificially colored.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cheese, ...	Jan. 20, 1902, ...	About three-fourths cream cheese.
Cheese, ...	Jan. 28, 1902, ...	About three-fourths cream cheese.
Full cream cheese, ..	Jan. 30, 1902, ...	Three-fourths cream.
Full cream cheese, ..	Jan. 29, 1902, ...	Pure full cream.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cheese, ...	Feb. 6, 1902, ...	Low in fat.
Cheese, ...	Feb. 27, 1902, ...	Somewhat deficient in fat.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cheese, ...	June 20, 1902, ...	Pure.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Milk, ...	Jan. 29, 1902, ...	Highly colored.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Milk, ...	Jan. 2, 1902, ...	Not adulterated.
Milk, ...	Jan. 2, 1902, ...	Poor milk.
Milk, ...	Jan. 2, 1902, ...	Not adulterated.
Milk, ...	Jan. 2, 1902, ...	Rich milk.
Milk, ...	Jan. 2, 1902, ...	Rich milk.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Milk Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
91,	2421,	E. M. Wiest,	928 Upland St., Chester,
92,	2419,	E. F. Flounders,	Brookhaven, Del. Co.,
93,	2420,	Jno. A. Springer,	1408 Edgemont Av., Chester,
82,	2411,	G. Longhead,	Boothwyn, Del. Co.,

Milk Analyses, March, 1902,

F. 166,	F. 166,	C. R. Fisher,	Monongahela City,

Milk Analyses, April, 1902,

W. A. H. 85,	W. A. H. 85,	E. G. Hall,	New Castle,
W. A. H. 86,	W. A. H. 86,	J. Bradchie,	New Castle,

Milk Analyses, April, 1902,

15,	2501,	Oran Long,	Carlisle,

Milk Analyses, March, 1902,

J. W. S. 394, 460 L.	A. 424,	C. D. Ross,	Diamond above 13th, Phila.,
463 L., J. M. S. 397.	A. 427,	U. S. Naval Home,	Gray's Ferry Road, Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Milk, ...	Jan. 7, 1902, ...	Sp. gr.=1030.8; fat= 3.80 per cent.; solids not fat=8.42 per cent; total solids, 12.22 per cent.
Milk, ...	Jan. 7, 1902, ...	Sp. gr=1032.1; fat=3.90 per cent.; solids not fat=8.75 per cent.; total solids, 12.65 per cent.
Milk, ...	Jan. 7, 1902, ...	Sp. gr.=1032.8; fat=3.8 per cent; solids not fat=8.92 per cent.; total solids=12.72 per cent.
Milk, ...	Jan. 2, 1902, ...	Contains added water.

F. T. Aschman, Chemist.

Milk, ...	Mar. 13, 1902, ...	No preservative found.

F. T. Aschman, Chemist.

Milk, ...	April 10, 1902, ...	Fat normal; not preserved.
Milk, ...	April 10, 1902, ...	Fat normal; not preserved.

C. B. Cochran, Chemist.

Milk, ...	April 5, 1902, ...	Sample is much too high in proteids and in this respect is abnormal.

F. A. Genth, Chemist.

Milk, ...	Mar. 8, 1902, ...	Pure.
Milk, ...	Mar. 10, 1902, ...	Not whole milk but skimmed.

Milk Analyses, May, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
W. A. H. 87,	W. A. H. 87,	J. Pitzer,	New Castle,
W. A. H. 89,	W. A. H. 89,	T. B. Boyles,	New Castle,
W. A. H. 89,	W. A. H. 89,	J. T. Mayo,	New Castle,
W. A. H. 90,	W. A. H. 90,	H. Hoge,	New Castle,
W. A. H. 91,	W. A. H. 91,	B. L. Cass,	New Castle,
W. A. H. 92,	W. A. H. 92,	David Bursharf,	New Castle,
W. A. H. 93,	W. A. H. 93,	L. H. Emerick,	New Castle,
W. A. H. 94,	W. A. H. 94,	New Castle Sanitary Mill Co.,	New Castle,
W. A. H. 95,	W. A. H. 95,	J. F. Holharan,	New Castle,

Milk Analyses, May, 1902,

1260,	2542,	E. W. Keller,	Sunbury,
1262,	2549,	E. W. Keller,	Sunbury,
1254,	2563,	C. S. Rockafeller,	Sunbury,
1275,	2561,	W. E. Diehl,	Danville,
1277,	2558,	W. E. Diehl,	Danville,
1255,	2572,	J. N. Beck,	Sunbury,
1256,	2557,	S. G. Kase,	Sunbury,
1259,	2571,	C. G. Rockafeller,	Sunbury,
1269,	2559,	S. Bergens,	Danville,
1271,	2543,	C. C. Dyer,	Danville,
1272,	2540,	Robert Farnsworth,	Danville,
1273,	2544,	C. C. Dyer,	Danville,
1278,	2560,	Robert Farnsworth,	Danville,
1270,	2562,	C. C. Dyer,	Danville,
1253,	2570,	Patrick Kelly,	South Bethlehem,
1261,	2564,	E. DeLong,	South Bethlehem,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.
Milk,	May 10, 1902,	Fat normal; not preserved.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Milk,	May 22, 1902,	Very heavily watered.
Skimmed milk,	May 22, 1902,	Contains about 15 per cent. of added water.
Cream,	May 22, 1902,	Artificially preserved.
Milk,	May 23, 1902,	Contains 30 per cent. added water.
Cream,	May 23, 1902,	Contains at least 50 per cent. added water; artificially colored.
Milk,	May 22, 1902,	Not adulterated.
Milk,	May 22, 1902,	No adulteration detected.
Milk,	May 22, 1902,	Not adulterated.
Milk,	May 23, 1902,	Sp. gr.=1033; fat=3.20 per cent.; solids not fat=9.03 per cent; total solids=12.23 per cent.
Milk (skimmed),	May 23, 1902,	Not adulterated.
Milk,	May 23, 1902,	Not adulterated.
Milk,	May 23, 1902,	Not adulterated.
Milk,	May 23, 1902,	Sp. gr.=1033; fat=3.80 per cent.; solids not fat=9.15 per cent; total solids=12.95 per cent.
Cream,	May 23, 1902,	Not adulterated.
Skimmed milk,	May 28, 1902,	Sp. gr.=1033; fat=1.2 per cent.; solids not fat=8.58 per cent.; total solids=9.78 per cent.
Milk,	May 28, 1902,	Test for formaldehyde not conclusive.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Milk Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
1274,	2568,	Patrick Kelly,	South Bethlehem,
1276,	2569,	E. DeLong,	South Bethlehem,
1287,	2567,	Patrick Kelly,	South Bethlehem,
1288,	2566,	Patrick Kelly,	South Bethlehem,
1289,	2565,	Patrick Kelly,	South Bethlehem,
17,	2574,	W. F. Swimm,	Briggs St., Harrisburg,
18,	2575,	E. E. Lutz,	Briggs St., Harrisburg,

Milk Analyses, June, 1902,

2592,	2592,	E. W. Keller,	Sunbury,

Pure Food Analyses, January, 1901,

L. 350, T. C. W. 96.	A. 330,	M. Lukoff,	1216 South St., Phila.,
L. 375,	A. 344,	Columbia Tea Co.,	3d and South Sts., Phila.,
J. M. S. 343, L. 378.	A. 347,	Chas. Shaw & Co.,	2310 N. 8th St., Phila.,
J. M. S. 342, L. 377.	A. 346,	Chas. Shaw & Co.,	2310 N. 8th St., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Night's milk,	May 28, 1902,	Sp. gr.=1031; fat=3.60 per cent.; solids not fat=8.60 per cent.; total solids=12.20 per cent.
Morning's milk,	May 28, 1902,	Sp. gr.=1.0301; fat=4.2 per cent.; solids not fat=8.48 per cent.; total solids=12.68 per cent.
Skim milk,	May 28, 1902,	Very low in solids not fat.
Milk,	May 28, 1902,	Sample is creamed milk.
Milk,	May 28, 1902,	Sp. gr.=1031; fat=3.65 per cent.; solids not fat=8.61 per cent.; total solids=12.26 per cent.
Milk,	May 30, 1902,	Not adulterated.
Milk,	May 30, 1902,	Not adulterated.

C. B. Cochran, Chemist.

Milk,	June 27, 1902,	Fat is too low; appears to be slightly skimmed.

F. A. Genth, Chemist.

Cocoa,	Instantaneous sweetened powder, equal parts ab. pure sugar and cocoa, Emile Aver & Co.'s.	Adulterated.
Cocoa,	Sherry's Pure Powdered Cocoa.	Chiefly ground cocoa shells.
Unsweetened chocolate.	Premium Plain Chocolate, Brewster Cocoa Mfg. Co., Jersey Cit. N. J.	Adulterated.
Cocoa,	Brewster's Caracas Cocoa, warranted absolutely pure, Brewster Cocoa Mfg. Co.	Adulterated.

Pure Food Analyses, August, 1901,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. H. S. 97,	A. 272, ...	Robinson & Crawford, ...	1654 Ridge Av., Phila., ...
J. M. S. 316,	A. 299, ...	Jas. McCurdy & Son, ...	2206 N. Front St., Phila., ...
P. H. S. 99,	A. 274, ...	Robinson & Crawford, ...	1654 Ridge Av., Phila., ...

Pure Food Analyses, September, 1901,

438, ...	2347, ...	People's Tea Co., ...	1007 N. 3d St., Harrisburg, ...

Pure Food Analyses, September, 1901,

L. 330, ...	A. 315, ...	Blumenthal Bros., ...	259 N. 3d St., Phila., ...
L. 332, ...	A. 317, ...	Ceylon Tea Co., ...	19th and South Sts., Phila., ...
L. 327, ...	A. 311, ...	Blumenthal Bros., ...	259 N. 3d St., Phila., ...

Pure Food Analyses, October, 1901,

W. 371, ...	W. 371, ...	B. C. Branden, ...	342 S. Main St., Washington,....

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Black pepper, ...	Aug. 8, 1901, 4.20 P. M.,	A dirty low grade pepper, ash and fiber too high for unadulterated goods.
Brewster's cocoa, ...	Brewster's Caracas Breakfast Cocoa, warranted absolutely pure, Brewster Cocoa Mfg. Co., Newark, N. J.	Adulterated.
Cayenne pepper, ...	Aug. 8, 1901, 4.20 P. M.,	Pure.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Lemon extract, ...	Bennett's Flavoring Extract of Lemon, guaranteed from all impurities, Bennett & Co., Phila.	Not pure lemon extract.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Orange color, ...	Sept. 24, 1901, 2.50 P. M.,	Orange yellow coal tar color.
Coffee, ...	Ariosa coffee, ...	Evidence of nitrogen compounds; traces of sugar, too small to determine.
Vanilla extract, ...	Sept. 17, 1901, 3.00 P. M.,	Not up to standard.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Vanilla extract, ...	White Cap Vanilla flavoring for ice cream, etc., Heekin Spice Co., Cincinnati, Ohio.	Artificially flavored and colored.

Pure Food Analyses, October, 1901,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
441, ...	2329, ...	E. A. Miller & Co., ...	1002 N. 3d St., Harrisburg, ...
1192, ...	2465, ...	J. Kupsky, ...	E. Center St., Shenandoah, ...
1191, ...	2466, ...	J. Kupsky, ...	E. Center St., Shenandoah, ...

Pure Food Analyses, October, 1901,

L. 338, ...	A. 323, ...	John C. Walter, ...	1219 S. 2d St., Phila., ...
J. M. S. 334,	A. 327, ...	John Wanamaker, ...	13th and Market Sts., Phila., ..

Pure Food Analyses, November, 1901,

H. L. B. 230,	H. L. B. 230,	H. C. Schwartz, ...	97-101 Grant St., Millvale, ...

Pure Food Analyses, November, 1901,

448, ...	2366, ...	Dives, Pomeroy & Stewart, ...	Harrisburg, ...
5, ...	2427, ...	Rec'd from Hon. J. K. Cope, ...	....

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Vanilla extract, ...	Clover Leaf Brand Extract Vanilla, Clover Leaf Extract Co., 215 Arch St., Phila.	Not pure extract of vanilla.
Pine apple syrup, ...	Old Virginia Pine Apple Syrup, Geo. K. McMechen & Son Co., Wheeling, West Va.	An artificial product sweetened with glucose.
Raspberry syrup, ...	Old Virginia Raspberry Syrup, Geo. K. McMechen & Son Co., Wheeling, West Va.	An artificial product sweetened with glucose and colored with coal tar color.

F. A. Genth, Jr., Chemist.

Coffee, ...	Ariosa coffee, ...	Evidence of nitrogeneous compounds; traces of sugar, too small to determine.
Mineral water tablets,	Sparklets Mineral Water Tablets, Vichey Gas Capsule Co., 1127 Broadway, N. Y.	An imitation of an actual vichy mixture with bicarbonate of soda and cream of tartar.

F. T. Aschman, Chemist.

Vanilla extract, ...	Zipp's 15 cents Pure Vanilla, Zipp Mfg. Co., Cleveland, Ohio.	Artificially flavored and colored.

C. B. Cochran, Chemist.

Grape juice, ...	Welch's Grape Juice, from choicest Concord grapes.	Preserved with salicylic acid.
Snider's home made catsup.	T. A. Snider Preserve Co., Cincinnati, Ohio.	Acid or coal tar color; no evidence of benzoic or boric acid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses, November, 1901,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
2,	2451,	Rec'd from Hon. J. K. Cope,	
3,	2450,	Rec'd from Hon. J. K. Cope,	
10,	2429,	Rec'd from Hon. J. K. Cope,	
9,	2440,	Rec'd from Hon. J. K. Cope,	
7,	2428,	Rec'd from Hon. J. K. Cope,	
8,	2384,	Rec'd from Hon. J. K. Cope,	
49,	2462,	James M. Hoar,	West Chester,
1193,	2396,	Geo. E. Herster,	1031 Ferry St., Easton,
50,	2414,	H. S. Dutton,	West Chester,
51,	2415,	H. S. Dutton,	West Chester,
52,	2407,	H. S. Dutton,	West Chester,
48,	2449,	James P. Harley,	Norristown,
59,	2430,	D. H. Shetrone,	Columbia,
64,	2416,	W. B. Hedrick,	Hatfield, Montgomery Co.,
57,	2448,	Mrs. Warden,	Columbia,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Ketchup,	Heintz Tomato Ketchup, Pittsburg.	Benzoic acid=0.18 per cent.; colored with coal tar color.
Ketchup,	Blue Label Tomato Ketchup, Curtice Bros., Co., Rochester, N. Y.	Benzoic acid=0.12 per cent.; does not seem to be artificially.
Ketchup,	Dove Brand Tomato Ketchup, Frank Vogel Co., Allegheny.	Benzoic acid=0.24 per cent.; colored with coal tar color.
Ketchup,	Sunnyside Ketchup, The Tiptop Ketchup Co., Cincinnati, Ohio.	Benzoic acid=0.02 per cent.; colored with eosin, a coal tar color.
Ketchup,	Lutz & Schramm, Diamond Pickling and Preserving Co., Allegheny.	Benzoic acid=0.22 per cent.; colored with a coal tar color.
Ketchup,	Van Camp's Tomato Ketchup.	Benzoic acid=0.22 per cent.; colored with a coal tar color.
Chocolate,	Penn Rose Drinking and Baking Chocolate.	Adulterated with wheat flour.
Ham,	November 8, 1901, A. M.,	Preserved with boric acid.
Strawberry extract,	Globe Absolutely Pure Extracts, Globe Extract Co., Boston, Mass.	Artificially colored.
Raspberry extract,	Globe Absolutely Pure Extracts, Globe Extract Co., Boston, Mass.	An artificial preparation.
Orange extract,	Globe Absolutely Pure Extracts, Globe Extract Co., Boston, Mass.	Not adulterated but low in orange.
Pepper,	Nov. 8, 1902, 12.35 P. M.,	Adulterated.
Vanilla extract,	Concentrated Extract of Vanilla, D. H. Shetrone, Columbia.	Adulterated, falsely labeled.
Cocoa,	Penn Rose Breakfast Cocoa, guaranteed strickley pure.	Contains about 15 per cent. cocoa husks.
White pepper,	Nov. 12, 1901, 7.00 P. M.,	Contains about 12 per cent. of added mineral matter.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name	Address.
63,	2463,	F. M. Nice,	Soudertown,
442 F.,	D. 438,	S. J. Seidle,	Altoona,

Pure Food Analyses, November, 1901,

T. C. W. 97, L. 351.	A. 331,	B. Foxstein,	1238 South St., Phila.,
T. C. W. 99, L. 353.	A. 333,	B. Foxstein,	1238 South St., Phila.,
T. C. W. 100, L. 354.	A. 334,	B. Foxstein,	1238 South St., Phila.,
L. 363,	A. 341,	C. F. Bonsor & Co.,	15 S. Front St., Phila.,
L. 362,	A. 340,	C. F. Bonsor & Co.,	15 S. Front St., Phila.,
L. 361,	A. 339,	C. F. Bonsor & Co.,	15 S. Front St., Phila.,
L. 359,	A. 337,	C. F. Bonsor & Co.,	15 S. Front St., Phila.,
L. 360,	A. 338,	C. F. Bonsor & Co.,	15 S. Front St., Phila.,
L. 358,	A. 336,	C. F. Bonsor & Co.,	15 S. Front St., Phila.,
P. H. S. 131,	A. 350,	Acme Tea Co.,	116 Market St., Phila.,

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Chocolate, ...	Premium Plain Chocolate, Brewster Mfg. Co., Jersey City.	Sample is adulterated with corn starch, apparently from 40 to 50 per cent.
Canned sweet corn, ..	The New Process Sugar Corn, W. Fleming, Portland, Me.	No preservative found.

Wm. Frear, Chemist.

Condensed milk, ...	Our own condensed milk,	Pure.
Canned cherries, ...	Park Brand Red Cherries, Howard Thomas, Fairport, N. Y.	Pure.
Canned tomatoes, ...	World Brand, first quality, Sam'l L. Kelty.	Pure.
Raspberry extract, ..	B. B. Brand Extract Raspberry, Bensor, Bright & Co., "artificial," Phila.	An artificial preparation.
Strawberry extract, ..	B. B. Brand Extract Strawberry, Benson, Bright & Co., "artificial," Phila.	An artificial preparation.
Vanilla extract, ...	Vanilla Extract Compound.	Compound, contains very little vanilla.
Vanilla extract, ...	Vanilla Extract Compound.	Compound, contains very little vanilla.
Lemon extract, ...	B. B. Brand, Bonsor, Bright & Co., lemon extract compound, Phila.	Contains a very little solution of oil of lemon.
Orange extract, ...	B. B. Brand, Bonsor, Bright & Co., orange extract compound, Phila.	Compound.
Black pepper, ...	Nov. 21, 1901, 3.55 P. M.,	A dirty low grade pepper.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. H. S. 130,	A. 349, ...	Acme Tea Co., ...	116 Market St., Phila., ...
J. M. S. 344, L. 379.	A. 348, ...	Chas. Shaw & Son, ...	2310 N. 8th St., Phila., ...

Pure Food Analyses, December, 1901,

H. L. B. 246,	H. L. B. 246,	Robert Crabbe, ...	Tylerdale Meat Market, Washington.
H. L. B. 247,	H. L. B. 247,	Byron C. Branden, ...	194 South Main St., Washington.
F. 446, ...	F. 446, ...	H. E. Deshong, ...	Altoona, ...
F. 445, ...	F. 445, ...	John P. Lafferty, ...	Altoona, ...
T. 151, ...	T. 151, ...	David Thompson, ...	1931 Forbes St., Pittsburg, ...

Pure Food Analyses, December, 1901,

74, ...	2390, ...	A. Pairman, ...	Franklyn Tea Co., Lancaster,..
77, ...	2425, ...	Diamond Glass Co., ...	Royersford, ...
77, ...	2405, ...	W. S. Mengin, ...	Chester, ...

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

--Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cayenne pepper, ...	Nov. 21, 1901, 3.55 P. M.,	Pure.
Sweet chocolate, ...	Brewster's Sweet Savoy Chocolate, made only from cocoa bean and sugar, Brewster Cocoa Mfg. Co., Jersey City, N. J.	Not absolutely pure.

F. T. Aschman, Chemist.

Sausage, ...	Dec. 27, 1901, ...	Preserved with boracic acid.
Sausage (minced ham).	Dec. 27, 1901, ...	Very heavily colored.
Pepper, ...	Blue Ribbon Brand, Austin, Nichols & Co., N. Y.	Pure.
Embalming fluid, ...	December 20, 1901, ...	Sample is a solution in water of formaldehyde and glycerine.
Peach preserves, ...	Brand, Dove, Frank Vogel Co., Allegheny.	Traces of preservatives found.

C. B. Cochran, Chemist.

Lard, ...	Dec. 4, 1901, 8.30 A. M.,	Sample is compound lard.
Vermont Maple Syrup,	Vermont Absolutely Pure Maple Syrup, Phila. Pickling Co., 262-264 S. 2d St., Phila.	Adulterated.
Cocoa, ...	Justice Brand, Cocoa Extract, W. H. Baker.	Adulterated (heavily).

Pure Food Analyses, December, 1901,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
L. 396,	A. 358,	W. J. Strange,	607 N. 2d St., Phila.,
L. 402,	A. 363,	John D. Farmaker,	1211 Market St., Phila.,
L. 393,	A. 355,	Columbia Tea Co.,	3d and South Sts., Phila.,
L. 397,	A. 359,	W. J. Strange,	607 N. 2d St., Phila.,
L. 406,	A. 362,	Columbia Tea Co.,	3d and South Sts., Phila.,

Pure Food Analyses, January, 1902,

F. 458,	F. 458,	W. A. Brown,	Osceola,
F. 447,	F. 447,	A. L. Peters,	Phillipsburg,
F. 448,	F. 448,	L. G. Kessler,	Phillipsburg,
F. 450,	F. 450,	M. I. Forcey,	Phillipsburg,
F. 453,	F. 453,	Geo. Richards,	Phillipsburg,
H. L. B. 250,	H. L. B. 250,	Fred. Baumberger,	220 W. Chestnut St., Washington,
M. 296,	M. 296,	Western Supply Co.,	223 5th Av., McKeesport,
W. A. H. 35,	W. A. H. 35,	W. R. McKee,	New Castle,
W. A. H. 40,	W. A. H. 40,	J. T. Aye,	Beaver Falls,
W. A. H. 41,	W. A. H. 41,	Mrs. J. B. Parris,	Beaver Falls,
F. 460,	M. 298,	John G. Dallman,	Stand 2, Market House, Alleg.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. A. Genth, Jr., Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cocoa,	Shields Brand, Empire Blended Breakfast Cocoa, Empire Chocolate Mills, N. Y.	Adulterated.
Candy,	Sugar bowl,	Adulterated with oxide of iron.
Horsh radish,	Dec. 5, 1901, 12.10 P. M.,	Pure.
Vanilla extract,	Extract Vanilla Compound.	Compound.
Condensed milk,	Meadow Brook Condensed Milk, W. H. Chaplain & Co., Phila.	Pure.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Bologna sausage,	Jan. 2, 1902,	Preserved with boracic acid.
Wienerwurst sausage,	Jan. 2, 1902,	Preserved and artificially colored.
Canned oysters,	Select Cherry Stone Lunch Oyster, packed by Martin, Wagner Co., Balto., Md.	Preserved with formaldehyde.
Bologna sausage,	Jan. 2, 1902,	Preserved with boracic acid or its compounds.
Bologna sausage,	Jan. 2, 1902,	Preserved with boracic acid.
Sausage,	Jan. 6, 1902,	Preserved with borax and colored.
Chopped beef,	Jan. 7, 1902, 11.45 A. M.,	Preserved with sulphites.
Banana extract,	Van Duzen's Fruit Extract, highly concentrated for flavoring (banana), Van Duzer's Extract Co., N. Y.	Artificially flavored and colored.
Vanilla extract,	Zipp's Pure Vanilla for flavoring, etc., Zipp Mfg. Co., Cleveland, Ohio.	Artificially flavored and colored.
Sausage (Frankfurter).	Jan. 10, 1902	Preserved with boracic acid or its compounds.
Chopped meat,	Jan. 22, 1902, 10.50 A. M.,	Preserved with sulphites.

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
F. 460,	F. 460,	G. J. Waddell,	Coalport,
F. 463,	F. 463,	Curry, Cannon & Co.,	Altoona,
F. 469,	F. 469,	R. S. Minich & Son,	Tyrone,
F. 468,	F. 468,	Wm. Hicks & Son,	Tyrone,
F. 467,	F. 467,	Wm. Hicks & Son,	Tyrone,
F. 466,	F. 466,	H. Miller,	Tyrone,
F. 455,	F. 465,	H. Miller,	Tyrone,
F. 452,	F. 452,	Baltic Supply Co.,	Phillipsburg,
F. 457,	F. 457,	Harry Emery,	Phillipsburg,
F. 456,	F. 456,	Nelson & Powell,	Phillipsburg,
F. 454,	F. 454,	Nelson & Powell,	Phillipsburg,
F. 455,	F. 455,	Nelson & Gould,	Phillipsburg,
F. 451,	F. 451,	Baltic Supply Co.,	Phillipsburg,
F. 449,	F. 449,	L. G. Kessler,	Phillipsburg,
H. L. B. 249,	H. L. B. 249,	C. Schmidt,	641 5th Av., Pittsburg,
H. L. B. 248,	H. L. B. 248,	Meik Bros.,	731 Wylie Av., Pittsburg,
H. L. B. 251,	H. L. B. 251,	Barnett & Kauffman,	1207 5th Av., Pittsburg,
H. L. B. 253,	H. L. B. 253,	Kaufmann's,	5th Av. and Smithfield St., Pittsburg.

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued. —Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Lemon extract, ...	The A. M. & O Extract of Lemon, Allen Mars's & Opdyke, 74-76 Murray St., N. Y.	Contains no oil of lemon; artificially colored with anilin yellow dye.
Evaporated cream, ..	Brand, Pet, Helvetia Condensing Co., Highland, Ill.	Artificially colored.
Sausage, ...	Jan. 30,, 1902, ...	Preserved and artificially colored.
Sausage, ...	Jan. 30, 1902, 2.30 P. M.,	Preserved with boracic acid.
Sausage, ...	Jan. 30, 1902, 2.30 P. M.,	'Preserved and artificially colored.
Sausage, ...	Jan. 30, 1902, 2.00 P. M.,	Preserved and artificially colored.
Chopped meat, ...	Jan. 30, 1902, 2.00 P. M.,	Preserved with sulphites.
Vanilla extract, ...	Brand: Bennet Flavoring Extract with a vanilla flavor, Bennett & Co., Phila.	Artificially flavored and colored.
Canned French peas,	Petits Pois Extra Pins, Guilliamy Fels, France.	Colored with copper.
Vanilla extract, ...	Brand: Nickel Extract with a vanilla flavor, U. S. Nickel, 45 S. 2d St., Phila.	Artificially flavored and colored.
Canned corn, ...	Brand: Mountain Sugar Corn, Louis McMurray Packing Co., Frederick City, Md.	Not preserved.
Canned salmon, ...	Jan. 2, 1902, ...	Not preserved.
Canned oysters, ...	Boyer's Cove Oysters, W. W. Boyer & Co., Baltimore, Md.	Not preserved.
Devilled crab, ...	Brand: Fresh Devilled Crabs, McMenamni & Co., Hampton, Va.	Not preserved.
Sausage, ...	Jan. 3, 1902, ...	Not preserved.
Liverpudding sausage,	Jan. 3, 1902, ...	Not preserved.
Bologna sausage, ...	Jan. 6, 1902, ...	Not preserved.
Canned oysters, ...	Brand: Rockaway Extra Select Lunch Oysters, John Boyle & Co., Baltimore, Md.	Not preserved.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
W. A. H. 33,	W. A. H. 33,	F. L. Boal,	New Castle,
H. L. B. 254,	H. L. B. 254,	G. M. Warrickson,	Washington,
F. 471,	F. 471,	H. E. Deshong by Armour & Co.	Altoona,
W. A. H. 53,	W. A. H. 53,	Henry Vogt,	Monaco,
W. A. H. 51,	W. A. H. 51,	J. R. McCherg,	Monaco,
H. L. B. 255,	H. L. B. 255,	H. H. Shanks,	175 N. Main St., Washington,
F. 462,	F. 462,	Penn Traffic Co.,	Johnstown,
F. 461,	F. 461,	John Thomas & Sons,	Johnstown,
F. 470,	F. 470,	A. A. Smith,	Tyrone,
H. L. B. 256,	H. L. B. 256,	Lonage & Densinore,	691 Jefferson Av., Washington,

Pure Food Analyses, January, 1902,

96,	2470,	Nelson & Newcomb,	Darby,
88,	2423,	F. M. Devers,	909 Upland St., Chester,
1202,	2433,	Thos. J. Horan,	Mahanoy City,
1203,	2453,	Thos. J. Horan,	Mahanoy City,
1201,	2472,	Thos. J. Horan,	Mahanoy City,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Sausage,	Jan. 9, 1902,	Not preserved.
Canned oysters,	Fresh Cove Oysters, "Jumbo," Miller & Co., Balto., Md.	Not preserved.
Sausage,	Jan. 20, 1902,	Not preserved.
Sausage,	Jan. 22, 1902,	Not preserved.
Ground mustard,	Coleman's Mustard,	Pure.
Canned oysters,	Cove Oysters, Verona Brand, Caralina Packing Co., Waverly, S. C.	Formaldehyde indicated.
Canned French peas,	Excelsior, Gabriel Triat & Co., Bordeaux, France, artificially colored.	Colored with copper.
Sausage,	Jan. 28, 1902, 4.20 P. M.,	Pure.
Ground cinnamon,	Superior Quality, Pure Cinnamon.	Cassia, not cinnamon.
Vanilla extract,	Brand: Anchor Mills, Extract of Vanilla, Detroit, Mich.	

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cocoa powder,	Webb's Pure Cocoa Powder, Milton, Mass.	Pure.
Cherry syrup,	Schimmel's Fruit Syrup, cherry, American Preserves Co., Phila.	Colored.
Cloves,	Reed, Stanton Co., Phila.	Not adulterated.
Ginger,	Puritan Mills Ginger, Reed, Santon Co., Phila.	Not adulterated.
Pepper,	Puritan Mills, purity guaranteed, Reed, Stanton Co., Phila.	Low grade, mineral matter too high.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
....	2417, ...	....	....
94, ...	2434, ...	S. J. Wright, ...	West Chester, ...
90, ...	2435, ...	Jacob Fulmer, ...	527 Market St., Standard Beef Co., Chester.
....	2454, ...	Rec'd from Dairy and Food Commissioner.	....
87, ...	2424, ...	F. M. Devers, ...	909 Upland St., Chester, ...
1210, ...	2452, ...	J. Z. Bergenstose, ...	Mahanoy City, ...
1211, ...	2464, ...	J. Z. Bergenstose, ...	Mahanoy City, ...
1216, ...	2458, ...	E. F. Kehler, ...	Shenandoah, ...
1217, ...	2461, ...	A. M. Molusky, ...	Shenandoah, ...
83, ...	2426, ...	Solomon Friedken, ...	315 Fulton St., Chester, ...
89, ...	2418, ...	F. M. Devers, ...	Chester, ...
1209, ...	2447, ...	J. C. Bergenstose, ...	Mahanoy City, ...
1208, ...	2479, ...	A. A. Beltz, ...	Weisport, ...
1220, ...	2456, ...	Martin Yadusky, ...	Shenandoah, ...
1218, ...	2455, ...	A. M. Molusky, ...	Shenandoah, ...
1219, ...	2471, ...	M. C. Ford, ...	Girardsville, ...

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cocoa,	Roses Ceylon Breakfast Cocoa, guaranteed pure, Cleveland Cocoa and Chocolate Co.	Not adulterated.
Sausage,	Jan. 8, 1902, 11.35 A. M.,	Preserved with boric acid, adulterated with corn starch.
Minced ham,	....	Boric acid=0.30 per cent.
Bedford cocoa,	Bedford Cocoa, J. M. Barker & Co., 91 Bedford Av., Brooklyn, N. Y.	Not adulterated.
Peach syrup,	Schimmel's Fruit Syrup, peach, American Preserve Co., Phila.	Not adulterated.
Ginger,	Puritan Mills, Reed & Stanton Co., Phila.	Not adulterated.
Allspice,	Puritan Mills, Reed & Stanton Co., Phila.	Not adulterated.
Pepper,	B. Fischer & Co., N. Y.,	Low grade.
Cheese,	Brand Goshen, ...	Too low in fat.
Sweet cider,	Jan. 2, 1902, 10.30 A. M.,	Not made from apples or pears; not cider.
Olive oil,	Hinle Lherb Veirge, E. Loubon, Nice.	Largely cotton seed oil.
Pepper,	Superior Pepper, warranted strickly pure, B. Fischer & Co.	Heavily adulterated.
Pepper,	B. Fischer, New York,..	Ground pepper hulls.
White clover honey,..	West Virginia Preserve Co., Wheeling, West Va.	Sample is glucose syrup.
White clover honey,..	The West Virginia Preserve Co., Wheeling, West Va.	Sample is glucose honey.
Pepper,	Fischer Mills, warranted absolutely pure, B. Fischer & Co., New York.	Heavily adulterated.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
97,	2491,	W. M. Focht,	Pottstown,
95,	2469,	W. M. Focht,	Pottstown,

Pure Food Analyses, January, 1902,

L. 405,	A. 366,	Atlantic and Pacific Tea Co.,	334 N. 8th St., Phila.,
J. M. S. 352, L. 410.	A. 369,	Thos. Hunter,	118 Market St., Phila.,
J. M. S. 353, L. 411.	A. 370,	Thos. Hunter,	118 Market St., Phila.,
J. M. S. 354, L. 4121.	A. 371,	Thos. Hunter,	118 Market St., Phila.,
J. M. S. 356, L. 414.	A. 373,	Comly Flanigan & Co.,	36-38 S. Front St., Phila.,
J. M. S. 355, L. 413.	A. 372,	Comly Flanigan & Co.,	36-38 S. Front St., Phila.,
J. M. S. 350, L. 408.	A. 367,	Thos. Hunter,	118 Market St., Phila.,
L. 416,	A. 375,	Wm. Butler,	11th and Jackson Sts., Phila.,
L. 417,	A. 376,	Wm. Butler,	11th and Jackson Sts., Phila.,
L. 419,	A. 378,	Geo. M. Dunlap,	10th and Wolf Sts., Phila.,
L. 421,	A. 380,	Cooley-Grocer,	7th and Jackson Sts., Phila.,
L. 415,	A. 374,	Wm. Butler,	11th and Jackson Sts., Phila.,
J. M. S. 357, L. 423.	A. 382,	Reading & Dickinson,	225 Race St., Phila.,

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Raspberry jelly, ...	Exwaco Raspberry Jelly, Exley Watkins & Co., Wheeling, W. Va.	An imitation article.
Webb's Cocoa Powder,	Jan. 29, 1902, 11.50 A. M.,	Not adulterated.
F. A. Genth, Jr., Chemist.		
Vanilla extract, ...	Extract Vanilla, Jan. 3, 1902, 11.45 A. M.	Pure.
Black pepper, ...	Jan. 9, 1902, 2.00 P. M.,	Low grade.
Cinnamon, ...	Jan. 9, 1902, 2.00 P. M.,	Pure.
Cloves, ...	Jan. 9, 1902, 2.00 P. M.,	Pure.
Sweet chocolate, ...	Brewster's Sweet, Savoy Chocolate.	Lightly adulterated.
Breakfast cocoa, ...	Shield's Empire Blended Breakfast Cocoa, 90 per cent. cocoa bean, 10 per cent. corn starch.	As represented.
Gooseberry jam, ...	Fresh fruit, gooseberry jam, preservatives present, Curtice Bros., Rochester, N. Y.	Pure.
Cream of tartar, ...	Jan. 16, 1902, 10.00 A. M.,	Pure.
Cayenne pepper, ...	Jan. 16, 1902, 10.00 A. M.,	Pure.
Cocoa, ...	Champion Brand Breakfast Cocoa, Geo. M. Dunlap, Phila.	Purity doubtful.
Cocoa, ...	W. H. Baker's Best Cocoa, Winchester, Virginia.	A low grade cocoa.
Cocoa, ...	Jan. 16, 1902, 10.00 A. M.,	Some foreign substance.
Hamburger steak, ...	Reading & Dickinson's choice Hamburger steak.	A mixture of beef, fat and pork.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
J. M. S. 360, L. 426.	A. 384,	Wm. Butler,	12th and Watkins Sts., Phila.,
J. M. S. 359, L. 425.	A. 383,	Wm. Butler,	12th and Watkins Sts., Phila.,
J. M. S. 382, L. 429.	A. 387,	Halpin, Green & Co.,	30 S. Front St., Phila.,
J. M. S. 367, L. 433.	A. 392,	Thos. Hunter,	19th and Market Sts., Phila.,
J. M. S. 371, L. 437.	A. 396,	Donahoe Bros.,	3520 Market St., Phila.,
P. H. S. 154,	A. 409,	Geo. B. Evans,	1106 Chestnut St., Phila.,
J. M. S. 379, L. 445.	A. 404,	Thos. Hunter,	1624 S. 10th St., Phila.,
P. H. S. 149,	A. 406,	Jas. Bell,	531 Girard Av., Phila.,
J. M. S. 351, L. 409.	A. 368,	Thos. Hunter,	118 Market St., Phila.,
L. 418,	A. 377,	Wm. Butler,	11th and Jackson Sts., Phila.,
J. M. S. 361, L. 427.	A. 385,	Kansas City Beef Co.,	1440 S. 8th St., Phila.,
J. M. S. 364, L. 430.	A. 389,	Donahoe Bros.,	3520 Market St., Phila.,
J. M. S. 369, L. 435.	A. 394,	Thos. Hunter,	19th and Market Sts., Phila.,
J. M. S. 375, L. 441.	A. 400,	Thos. Hunter,	1624 S. 10th St., Phila.,
J. M. S. 376, L. 442.	A. 401,	Thos. Hunter,	1624 S. 10th St., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Lard,	Jan. 18, 1902, 12.05 P. M.,	Pure.
Strawberry jam,	Fresh fruit, strawberry jam, small amount preservatives, Curtice Bros., Rochester, N. Y.	Pure.
Brewster's Cocoa,	Brewster's Caracas Breakfast Cocoa, Brewster's Cocoa Mfg. Co., Newark, N. J.	Fairly pure (foreign starch).
Flour,	Gordon's Best, Gordon's Mills.	Pure.
Lard,	Jan. 22, 1902, 11.20 A. M.,	Compound lard.
Infants food,	Jan. 25, 1902,	A carefully prepared article.
Celery salt,	Jan. 24, 1902, 12.00 M.,	Pure.
Java blend coffee,	Jan. 29, 1902, 5.40 P. M.,	Pure.
Allspice,	Pure allspice,	Adulterated probably with clove stems.
Chocolate,	Butler's Premium Chocolate, mfg. from choicest cocoa bean, entire satisfaction guaranteed, Wm. Butler, Phila.	Heavily adulterated with corn starch.
Lard,	Jan. 18, 1902, 1.10 P. M.,	Compound lard.
Honey,	Jan. 21, 1902, 1.00 P. M.,	Contains small amounts of glucose.
Maple syrup,	Standard Maple Syrup, The American Preserve Co., Phila.	Ash too low, flavored to resemble maple syrup.
New Orleans molasses,	Jan. 28, 1902, 12.00 M.,	Glucose syrup.
Lard,	Jan. 28, 1902, 12.00 M.,	Compound lard.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
J. M. S. 365, L. 431.	A. 390,	Herman Bros.,	3612 Market St., Phila.,
J. M. S. 378, L. 444.	A. 403,	Thos. Hunter,	1624 S. 10th St., Phila.,
J. M. S. 363, L. 428.	A. 386,	Barber & Perkins,	28 N. Delaware Av., Phila.,
J. M. S. 372, L. 438.	A. 397,	George Miller & Son Co.,	255-7 S. 3d St., Phila.,
J. M. S. 366, L. 432.	A. 391,	Croft & Allen,	33d and Market Sts., Phila.,

Pure Food Analyses, January, 1902,

Agent's number and mark.	Chemist's number and mark.	Name.	Address.
162,	333,	John I. Reese,	Carbondale,
164,	335,	J. J. Higgins,	Carbondale,
161,	334,	John J. Reese,	Carbondale,

Pure Food Analyses, February, 1902,

Agent's number and mark.	Chemist's number and mark.	Name.	Address.
F. 477,	F. 477,	T. Deitrich,	Curwensville,
F. 478,	F. 478,	A. J. McNank,	Curwensville,

F FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Extract vanilla, ...	Concentrated Fruit Extract Vanilla, Hermann Bros.	Compound.
Pepper, ...	Jan. 28, 1902, 12.00 M.,....	Low grade.
Chocolate, ...	Levering's Chocolate, Levering's Chocolate Co., Baltimore, Md.	Apparently pure.
Cocoa, ...	Excelsior Cocoa, Geo. Miller Son & Co.	A low grade sample containing husks and a small amount of foreign cereals, hence doubtful points.
Chocolate, ...	Pan-American Chocolate, Croft & Allen, Phila.	Adulterated with cereals apparently cornstarch.

Albert H. Wells, Chemist.

Catsup, ...	White Label Tomato Catsup, M. Seheonberg & Co., N. Y.	Artificially colored preserved with sodium benzoate.
Vanilla extract, ...	Eagle Extract Vanilla Compound, compound letters not as large as vanilla, Clawson Co., 45 S. 2d St., Phila.	Not true extract of vanilla, not correctly labeled.
Vanilla extract, ...	Perfection Extract Vanilla (small letters Tonka bean, .04 sugar, .12 diluted alcohol, 128 color traces), Perfection Extract Co., N. Y.	Not true extract of vanilla, not correctly labeled.

F. T. Aschman, Chemist.

Sausage, ...	Feb. 6, 1902, 8.10 A. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 6, 1902, 8.20 A. M.,	Preserved with boracic acid.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
F. 475, ...	F. 475, ...	L. W. Spencer & Co., ...	Curwensville, ...
F. 479, ...	F. 479, ...	Peter Kreher, ...	Clearfield, ...
F. 484, ...	F. 484, ...	Charles Sheffer, ...	DuBois, ...
F. 485, ...	F. 485, ...	Hoffman & Daun, ...	DuBois, ...
F. 486, ...	F. 486, ...	Hugh A. Easton, ...	DuBois, ...
F. 487, ...	F. 487, ...	Rilling & Winner, ...	DuBois, ...
F. 481, ...	F. 481, ...	F. F. Keller, ...	Clearfield, ...
F. 491, ...	F. 491, ...	Charles Weir, ...	DuBois, ...
T. 155, ...	T. 155, ...	H. Anderson & Co., ...	Ingram, ...
W. A. H. 60,	W. A. H. 60,	R. J. Jamison, ...	Beaver Falls, ...
T. 157, ...	T. 157, ...	H. W. Gieske, ...	637 Herron Av., Pittsburg, ...
W. A. H. 68,	W. A. H. 68,	A. G. Harvey, ...	New Brighton, ...
W. A. H. 67,	W. A. H. 67,	A .G. Harvey, ...	New Brighton, ...
W. A. H. 72,	W. A. H. 72,	Geo. H. Cross, ...	Rochester, ...
T. 159, ...	T. 159, ...	P. H. Butler, ...	4122 Butler St., Pittsburg, ...

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.
—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Pine apple extract, ...	Elite (no compound label), R. C. Williams & Co., New York.	Artificially flavored and colored.
Sausage, ...	Feb. 6, 1902, 9.40 A. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 6, 1902, 2.40 P. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 6, 1902, 2.50 P. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 6, 1902, 2.55 A. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 6, 1902, 3.00 P. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 6, 1902, 10.15 A. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 7, 1902, 9.00 A. M.,	Preserved with boracic acid.
Lemon extract, ...	Ruley Brand, concentrated extract of lemon, Jas. Ateer & Son, Pittsburg.	Artificially flavored and colored, not lemon extract.
Vanilla extract, ...	Brand: Zipp's Pure Vanilla Extract, Zipp Mfg. Co., Cleveland, Ohio.	Artificially flavored and colored.
Ground pepper, ...	Brand: Pure Spices (no manufacturers name or address).	Not pure pepper.
Lemon extract, ...	Brand: Zipp's 10 cent lemon extract for flavoring, etc., Zip Mfg. Co., Cleveland, Ohio.	Artificially flavored and colored, not lemon extract.
Vanilla extract, ...	Brand: Zipp's Pure Vanilla extract for flavoring, etc., Zipp Mfg. Co., Cleveland, Ohio.	Artificially flavored and colored.
Almond extract, ...	Brand: Pure Extract Almond, Frank E. Harris, Binghamton, New York.	Artificial.
Maple syrup, ...	Brand: Pure Quebec Maple Syrup, The Williams Bros. & Co. (this is made from the finest maple sugar), Detroit, Mich.	Not maple syrup.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
F. 480,	F. 480,	Crissman & Co.,	Clearfield,
F. 483,	F. 483,	Richard Massop,	Clearfield,
F. 488,	F. 488,	L. A. Fisher,	DuBois,
F. 490,	F. 490,	W. H. Young,	DuBois,
F. 489,	F. 489,	S .E. Lenkard,	DuBois,
F. 482,	F. 482,	Humphrey Bros.,	Clearfield,
F. 476,	F. 476,	Geo. Kittelberger,	Curwensville,
W. A. H. 64,	W. A. H. 64,	L. E. Bowers,	Beaver Falls,
W. A. H. 69,	W. A. H. 69,	Milo F. Wilson,	New Brighton,
W. A. H. 71,	W. A. H. 71,	C. E. Holman,	Rochester,
W. A. H. 70,	W. A. H. 70,	C. E. Holman,	Rochester,

Pure Food Analyses, February, 1902,

1221,	2467,	John Hancock,	Shamokin,
1222,	2481,	S. Schreiver & Co.,	Easton,
1223,	2480,	Wenner Bros.,	Allentown,
1235,	2488,	O. F. Philips,	Stroudsburg,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued. —Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Preserved strawberries.	Shield Brand, J. S. Farren & Co., Baltimore, Md.	Pure.
Canned oysters, ...	Hampton Bar Lunch Oysters, Moore & Brady, Baltimore, Md.	No preservatives found.
Canned corn, ...	Chatham Sugar Corn, Chatham Packing Co., Phila.	Not preserved.
Canned oysters, ...	Warsaw Cove Oysters, Varn Byrd & Co., Thunderbolt, Ga.	Not preserved.
Noodles, ...	"Golden Egg Noodles" compound, The French Delicacy Co., Cleveland, Ohio.	Not according to formula on box.
Sausage, ...	Feb. 6, 1902, 10.42 A. M.,	Pure.
Sausage, ...	Feb. 6, 1902, 8.00 A. M.,	Pure.
Sausage, ...	Feb. 26, 1902, 4.00 P. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 27, 1902, 9.30 A. M.,	Not preserved.
Sausage, ...	Feb. 27, 1902, 11.00 A. M.,	Preserved with boracic acid.
Sausage, ...	Feb. 27, 1902, 11.00 A. M.,	Preserved with boracic acid.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Pepper, ...	Our Best Pepper, perfect purity guaranteed, J. P. Dieter & Co., Chicago.	Heavily adulterated.
Cocoa, ...	Schreiver's Gold Meal Breakfast Cocoa, absolutely pure cocoa.	Adulterated.
Pepper, ...	Chicago Brand, strictly pure black pepper, Hudson Mfg. Co., N. Y.	Adulterated.
Maple syrup, ...	Brand: Goyer's Maple Syrup, C. W. Goyer & Co., Memphis, Tenn.	Heavily adulterated with glucose syrup.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
1226,	2533,	Schuylkill Supply Co.,	St. Clair,
1225,	2486,	George E. Farne,	St. Clair,
1229,	2493,	J. Shotwell & Son,	E. Stroudsburg,
1240,	2487,	James Weidman,	Bangor,
1241,	2492,	James Weidman,	Bangor,
	2473,	From Hon. Jesse K. Cope,	
1227,	2497,	S. J. Whims,	St. Clair,
1230,	2506,	J. Shotwell & Son,	E. Stroudsburg,
1239,	2496,	James Weidman,	Bangor,
1238,	2504,	James Weidman,	Bangor,
1242,	2503,	S. J. Weidman,	Penn Argyle,

Pure Food Analyses, February, 1902,

J. M. S. 389, L. 455.	A. 422,	Estate of Wm. Butler,	3528 Market St., Phila.,
J. M. S. 386, L. 452.	A. 416,	Schuerer & Co.,	Easton,
S. M. R. 1222,	A. 423,	Wm. Butler,	3528 Market St., Phila.,
J. M. S. 390, L. 456.	A. 420,	Estate of Wm. Butler,	3528 Market St., Phila.,
J. M. S. 387, L. 453.	A. 419,	Estate of Wm. Butler,	3528 Market St., Phila.,
J. M. S. 384, L. 450.	A. 417,	Columbian Tea House,	3651 Market St., Phila.,

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Clover honey, ...	Bromunds Leading Clover Honey, the comb honey is pure.	Not properly labeled.
Clover honey, ...	Bromunds Leading Clover Honey, the comb honey is pure.	Not properly labeled.
Ground yellow mustard.	Feb. 25, 1902, 12.00 M.,..	Contains about 75 per cent. wheat.
Clover honey, ...	Bromund's Leading Clover Honey, the comb honey is pure.	Not properly labeled.
Strawberry jelly, ...	Flavor fruit jelly, strawberry, Logan, Johnston Co., Boston, Mass.	Not strawberry jelly, but was marked "sold for strawberry jelly."
Lard, ...	....	Pure.
Lard, ...	Feb. 21, 1902, ...	Contains beef fat.
Pepper, ...	Sold for pure pepper, ...	Pure.
Chocolate, ...	Weidman's Good Chocolate.	Adulterated slightly.
Pepper, ...	Feb. 27, 1902, 11.50 A. M.,	Not adulterated.
Pepper, ...	Feb. 28, 1902, A. M.,.....	Not adulterated.

F. A. Genth, Chemist.

Vanilla extract, ...	Pure Extract Vanilla, Royal Mfg. Co., Phila.	A weak solution, sample too small.
Cocoa, ...	Sent in exchange for samples 1023 and 1035.	Adulterated.
Lemon extract, ...	Royal Pure Extract Lemon, Royal Mfg. Co., Phila.	Artificial preparation, containing about one per cent. of lemon.
Lard, ...	One pound pure lard, ...	Compound lard.
New Orleans molasses,	Feb. 27, 1902, 12.45 P. M.,	Adulterated with glucose.
New Orleans molasses,	Feb. 27, 1902, 12.30 P. M.,	Over one-half glucose.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
J. M. S. 384, L. 450.	A. 408,	George B. Evans,	1106 Chestnut St., Phila.,
P. H. S. 155,	A. 410,	Hanscoins,	1311 Market St., Phila.,
J. M. S. 581, L. 447.	A. 411,	Mrs. ———,	2803 Germantown Av., Phila.,

Pure Food Analyses, February, 1902.

F. 474,	D. 448,	L. G. Kessler,	Philipsburg,

Pure Food Analyses, March, 1902,

T. 162,	T. 162,	John Homley,	665 Preble Av., Pittsburg,
T. 173,	T. 173,	Martin Gurys,	820 Carson St., S. S., Pittsburg,
W. 404,	W. 404,	Albert Mozike,	7 Fourth St., Rankin,
T. 176,	T. 176,	Wm. Hubner,	1630-32 5th Av., Pittsburg,
T. 163,	T. 163,	Kohler & Evans,	193-5 Beaver Av., Allegheny,
C. 12,	C. 12,	Nichols Chechary,	Cambridge Springs,
T. 169,	T. 169,	J. L. Gardner,	Grant Av. & Sheridan St., Bennett.

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Hurlick's Food for Infants.	Feb. 10, 1902, 10.55 A. M.,	The same as P. H. S. 154.
Raspberry jam, ...	Raspberry Jam, Hauscom's Bros.	Pure.
Honey, ...	A. Schnieder's Genuine Flower Honey, Baeder's Farm, Jenkintown.	Pure.

Wm. Frear, Chemist.

Canned oysters, ...	Select cherry stone lunch oysters, Martin Wagner, 2315-17 Boston St., Baltimore, Md.	No formaldehyde present.

F. T. Aschman, Chemist.

Lemon extract, ...	Brand: Pure concentrated extract of lemon (no mfg. name or address).	Not lemon extract.
Lemon extract, ...	Brand: Extract of lemon, Pittsburg (no manufactures name).	Not lemon extract.
Lemon extract, ...	Brand: Concentrated lemon extract, Gross & Co., New York.	Not lemon extract, artificially flavored and colored.
Maple syrup, ...	Brand: Old Homestead Maple Syrup, Falcon Packing Co., N. Y.	Spurious.
Maple syrup, ...	Brand: Pure Vermont Maple Syrup, Price & Lucas, Louisville, Ky.	Apparently pure.
Maple syrup, ...	Mar. 14, 1902, 4.00 P. M.,	Pure.
Maple syrup, ...	Mar. 15, 1902, 11.05 A. M.,	Pure.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
T. 171,	T. 171,	Brand Bros.,	5119 Butler St., Pittsburg,
F. 494,	F. 494,	A. I. McNaul,	Curwensville,
M. 312,	M. 312,	H. Hepner,	1801 Wylie Av., Pittsburg,
W. 407,	W. 407,		25 Jefferson St., Washington,

Pure Food Analyses, March, 1902,

Agent's number and mark.	Chemist's number and mark.	Name.	Address.
101,	2510,	J. Allen Harley,	Lansdale Mfg. Co.,
458,	2517,		
102,	2511,	M. R. Hunsberger,	Lauderton,
	2495,	John Kaufman,	New Castle,
1246,	2500,	E. Warren,	Lansford,
1245,	2509,	E. Warren,	Lansford,
103,	2513,	C. Schoeple,	7th and Rhenny Sts., Reading,
	2516,	F. Frank Woodside,	
105,	2519,	Barth Bros.,	463 N. 13th St.,
104,	2521,	J. M. Alt,	Reading,
107,	2514,	Hoff & Bros.,	Reading,
106,	2532,	Wm. Tregay,	316 N. 12th St., Reading,
110,	2531,	Daniel Y. Knapp,	741 Penn St., Reading,
111,	2507,	Daniel Y. Knapp,	Reading,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued. —Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cream of tartar, ...	Mar. 21, 1902, 3.23 P. M.,	Pure.
Ham, ...	Mar. 24, 1902, 5.50 P. M.,	Pure.
Cream of tartar, ...	Mar. 24, 1902, 4.10 P. M.,	Pure.
Lemon extract, ...	Brand: Anchor Mill Extract Lemon, Detroit, Mich.	Artificial.

C. B. Cochran, Chemist.

Pepper, ...	Mar. 11, 1902, 3.00 P. M.,	Adulterated with mineral matter and pepper hulls.
Egg flake, ...	The Pure Food's Co. Egg Flake.	Not adulterated.
Chocolate, ...	Brand: Premium Plain Chocolate, Brewster Cocoa Mfg. Co., Jersey City, N. J.	Heavily adulterated.
Granulated sugar, ...	....	Pure.
Chocolate, ...	Brand: Levering Chocolate Premium No. 1, guaranteed 100 per cent pure cocoa bean.	Contains cocoa husks.
Cocoa, ...	Levering's Absolutely Pure Cocoa, Levering Chocolate Co., Balto., Md.	Not adulterated.
Bologna sausage, ...	Mar. 20, 1902, 9.30 A. M.,	Not adulterated.
Vanillabene, ...	Vanillabene Co., Uwchland, Chester.	I am unable to tell source of vanillin crystals; cane sugar 95.8 per cent.
Lard, ...	Mar. 25, 1902, 2.45 P. M.,	Pure.
Raspberry preserves,..	Fritz's Preserves, Raspberries, home made, marked compound in very small letters.	Contains glucose.
Cayenne pepper, ...	Mar. 26, 1902, 10.30 A. M.,	Either extract very low, probably exhausted.
Lard, ...	Mar. 26, 1902, 12.15 P. M.,	Adulterated (some).
Brown mustard, ...	Mar. 27, 1902, 9.00 A. M.,	Pure.
Black pepper, ...	Mar. 27, 1902, 9.00 A. M.,	Pure.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses, March, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
17,	D. 453,	S. M. Baer,	247 N. 6th St., Reading,
13,	D. 457,	U. B. Brewster,	Jersey Shore,
12,	D. 456,	W. B. Brewster,	Jersey Shore,
10,	D. 454,	James Everhart Mfg.	South Newport,
11,	D. 455,	N. A. Confer,	Harrisburg,
14,	D. 458,	U. B. Brewster,	Jersey Shore,

Pure Food Analyses, March, 1902,

J. M. S. 395, L. 461.	A. 425,	Merril & Hopper,	10-12 N. 10th St., Phila.,
J. M. S. 398, L. 464.	A. 428,	Strawbridge & Clothier,	815 Market St., Phila.,
J. M. S. 401, L. 468.	A. 431,	John Canning,	22d and Spruce Sts., Phila.,
J. M. S. 400, L. 467.	A. 430,	Bernard Off & Sons,	259-61 S. 20th St., Phila.,
J. M. S. 403, L. 470.	A. 433,	Geo. M. Dunlap,	10th and Ellsworth Sts., Phila.,
J. M. S. 408, L. 476.	A. 437,	Robinson & Crawford,	21st and Market Sts., Phila.,
J. M. S. 410, L. 478.	A. 439,	James Dobbins & Son,	20th and Market Sts., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Wm. Frear, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Chocolate,	C. B. C. No. 2328,	Contains added starch, probably corn.
Acme lunch cocoa,	Acme Lunch Cocoa, rich chocolate flavor, Brewster Mfg. Co., Jersey City, N. J.	Contains added starch.
Cocoa,	Labeled like D. 455, absolutely pure cocoa from which excess of oil has been removed.	No foreign admixture found.
Sifted corn meal,	No. D. & F. Comm'r,	Pure.
Cocoa,	Brewster's Caracas Breakfast Cocoa, Brewster Cocoa Mfg. Co., Jersey City, N. J.	Pure.
Chocolate,	Premium Plain Chocolate, a superior article for table use, Brewster Mfg. Co., Jersey City, N. J.	Contains added starch, probably corn.

F. A. Genth, Chemist.

Evaporated peaches,	Mar. 3, 1902, 1.30 P. M.,	Pure.
Vanilla extract,	Extract vanilla, Strawbridge & Clothier, Phila.	Pure.
Maple syrup,	Sap Maple Syrup, Curtice Bros., Rochester, N. Y.	Apparently genuine.
Maple syrup,	"Log Cabin Maple Syrup."	Apparently genuine.
Lard,	Mar. 14, 1902, 11.50 P. M.,	Apparently genuine.
Molasses,	Mar. 17, 1902, 12.35 P. M.,	Pure.
Molasses,	Mar. 17, 1902, 12.45 P. M.,	Pure.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
J. M. S. 411, L. 479.	A. 450,	J. D. Formakes,	1211 Market St., Phila.,
J. M. S. 414, L. 482.	A. 452,	Emile Koehler,	124 N. 8th St., Phila.,
J. M. S. 415, L. 483.	A. 453,	John Wanamaker,	13th and Market Sts., Phila.,
J. M. S. 417, L. 485.	A. 455,	G. W. Coles,	114 Market St., Phila.,
J. M. S. 422, L. 490.	A. 458,	Martin L. Detsch,	2548 Germantown Av., Phila.,
J. M. S. 421, L. 489.	A. 457,	Edward Wolf,	2615 Germantown Av., Phila.,
J. M. S. 432, L. 500.	A. 447,	Columbia Tea Co.,	4507 Frankford St., Phila.,
J. M. S. 399, L. 465.	A. 429,	Strawbridge & Clothier,	8th and Market Sts., Phila.,
J. M. S. 424, L. 496.	A. 460,	B. Rosenberg,	1302 South St., Phila.,
J. M. S. 423, L. 491.	A. 459,	Packing House Co.,	1208 South St., Phila.,
J. M. S. 420, L. 488.	A. 456,	John H. Geltz,	2822 Germantown Av., Phila.,
J. M. S. 426, L. 494.	A. 441,	Joseph W. Ennis,	29th and Stiles Sts., Phila.,
J. M. S. 428, L. 496.	A. 443,	W. J. Strange,	4435 Frankford Av., Phila.,
J. M. S. 431, L. 499.	A. 446,	Columbia Tea House,	4507 Frankford Av., Phila.,
J. M. S. 434, L. 502.	A. 449,	Holmes Bros.,	4681 Frankford Av., Phila.,
J. M. S. 433, L. 501.	A. 448,	Columbia Tea House,	4507 Frankford Av., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Chocolate eggs, ...	Mar. 20, 1902, 11.25 A. M.,	Pure.
Chocolate eggs, ...	Mar. 20, 1902, ...	Pure.
Chocolate eggs, ...	Mar. 21, 1902, 12.10 P. M.,	Pure.
Chocolate eggs, ...	Mar. 21, 1902, 1.00 P. M.,	Pure.
Lard, ...	Mar. 22, 1902, 10.30 A. M.,	Compound.
Lard, ...	Mar. 22, 1902, 10.20 A. M.,	Pure.
Maple syrup, ...	Mar. 25, 1902, 1.25 P. M.,	Pure.
Lemon extract, ...	Extract lemon, Strawbridge & Clothier, Phila.	Artificial preparation, about one per cent. lemon.
Lard, ...	Mar. 22, 1902, 11.35 A. M.,	Compounded with twice its amount of cotton seed oil.
Lard, ...	Mar. 22, 1902, 11.30 A. M.,	Compound.
Lard, ...	Mar. 22, 1902, 10.05 A. M.,	Compound.
Molasses, ...	Mar. 24, 1902, 12.00 M., ..	Chiefly glucose.
Molasses, ...	Mar. 25, 1902, 1.10 P. M.,	Chiefly glucose.
Molasses, ...	Mar. 25, 1902, 1.25 P. M.,	Chiefly glucose.
Molasses, ...	Mar. 25, 1902, 1.35 P. M.,	Chiefly glucose.
Lemon extract, ...	Nickel lemon for flavoring, etc., U. S. Nickel, 45 S. 2d St., Phila.	Artificial preparation, less than one per cent. lemon.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses, March, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
173,	342,	M. G. Finalberry,	Auburn Center,
172,	341,	M. G. Finalberry,	Auburn Center,

Pure Food Analyses, April, 1902,

H. 76,	H. 76,	Union Supply Co.,	Fairchance,
M. 325,	M. 325,	E. A. Kimmich,	Stalls 101-114 Pittsburg Market, Pittsburg.
	C. 19,	Don M. Rigby,	Mercer,

Pure Food Analyses, April, 1902,

	2534,	This sample left by Mr. Little was examined at the request of the D. & F. Commissioner.	
	2498,	J .M. Knoll,	
113,	2515,	James Trainer,	701 Green St., Chester,
117,	2522,	J. F. Forney,	Reading,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Albert H. Wells, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Lemon extract, ...	IXL Lemon, C. F. Sutterland & Sons, Wilkes-Barre.	Satisfactory.
Vanilla, ...	Perfection extract vanilla (compound in small letters), Perfection Extract Co., N. Y.	Not to the name, artificially colored.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Pine apple extract, ..	Brand: Eclipse Pineapple for flavoring, etc., Yough Chemical Co., Connellsville.	A compound.
Country sausage, ...	April 11, 1902, 2.25 P. M.,	Preserved with sulphites.
Vanilla extract, ...	Brand: Luxury Extract of Vanilla, F. H. Leggett & Co., New York, N. Y.	Within requirements.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Champion No. 1 Premium Chocolate.	Mfg. by Crave & Martin Co., wrapper marked in New York, small letters, "Improved Compound Preparation."	Not properly labeled.
Cocoa, ...	Bedford Cocoa, J. H. Barker & Co.	Adulterated with husks of the cocoa bean.
Sweet chocolate, ...	Crescent Vanilla Sweet Chocolate, Brewster Cocoa Mfg. Co.	Adulterated with flour.
Minced ham, ...	April 15, 1902, 4.00 P. M.,	Sample gave no test for boric acid, nor for coal tar color.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
119,	2523,	J. F. Forney,	Reading,
118,	2524,	J. F. Forney,	Reading,
115,	2525,	John Yearger,	Tuckerton,
116,	2528,	John Yearger,	Tuckerton,
114,	2529,	John Yearger,	Tuckerton,
364,	2527,		
348,	2526,		
	2530,		
120,	2586,	H. Lutton,	Chester,
B. 1248,	2518,	Ira Herb,	Tremont,
121,		Herman Bros.,	3612 Market St., Phila.,

Pure Food Analyses, April, 1902,

D. & F. Commis'r, 16.	476,	F. F. Woodside,	Uwchland,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Fresh sausage, ...	April 15, 1902, 4.00 P. M.,	Sample gave no test for boric acid, nor for coal tar color.
Bologna, ...	April 15, 1902, 4.00 P. M.,	Sample contains boric acid in small quantities, about one-fourth per cent.
Smoked beef, ...	April 15, 1902, 11.00 A. M.,	Does not contain boric acid.
Sausage, ...	April 15, 1902, 11.00 A. M.,	Does not contain boric acid and is not colored.
Beef for making sausage.	April 15, 1902, 11.00 A. M.,	Not adulterated.
Honey, ...	From F. A. Genth, ...	Probably contains glucose syrup or from bees fed on glucose.
Honey, ...	From F. A. Genth, ...	Probably contains glucose syrup or from bees fed on glucose.
Maple syrup, ...	....	Does not contain glucose, but may contain cane sugar syrup.
"Getsum" Cocoa, ...	"Getsum" Cocoa, put up by United Grocery Co., 85 Wall St., N. Y., guaranteed absolutely free from adulteration and made only from selected cocoa beans.	Adulterated.
Pepper, ...	Brand: Pure Black Pepper.	Contains one pound of foreign mineral matter to ten pounds of pepper; too high in ash.
Extract vanilla, ...	May 12, 1902, ...	Not extract of vanilla.

Wm. Frear, Chemist.

"Vanillabene,"	Two oz. vanillabene; equal in flavoring powder to 4 oz. of the best vanilla extract, price 20 cents.	Not adulterated; name apparently not misleading.

Pure Food Analyses, April, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
J. M. S. 499, L. 518.	A. 467, ...	Thomas Hunter, ...	8th and Montgomery Av., Phila.,
J. M. S. 457, L. 526.	A. 470, ...	Grocery store, ...	1210 South St., Phila., ...
J. M. S. 459, L. 528.	A. 471, ...	Chas. L. Heinle, ...	2731 Kensington Av., Phila., ...
J. M. S. 465, L. 534.	A. 476, ...	George M. Dunlap, ...	1816 S. 2d St., Phila., ...
P. H. S. 165,	A. 477, ...	A. Weinfield, ...	529 N. 2d St., Phila., ...
J. M. S. 440, L. 509.	A. 463, ...	Thomas Hunter, ...	28th and Girard Av., Phila.,....
J. M. S. 442, L. 511.	A. 446, ...	Martin Detsch, ...	2548 Germantown Av., Phila.,....
J. M. S. 446, L. 465.	A. 465, ...	Phila. Beef Co., ...	365 N. 2d St., Phila., ...
J. M. S. 451, L. 520.	A. 469, ...	J. K. Horner, ...	16th and Cumberland Sts., Phila.
L. 420, ...	A. 379, ...	Geo. Dunlap, ...	10th and Wolf Sts., Phila., ...
J. M. S. 461, L. 530.	A. 473, ...	Merril & Hooper, ...	10-12 N. 12th St., Phila., ...
J. M. S. 464, L. 533.	A. 475, ...	Wm. Butler, ...	1729 S. 2d St., Phila., ...
J. M. S. 463, L. 532.	A. 474, ...	H. S. Rorer & Son, ...	3 Spreckels Building Stock Exchange, Place.

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Lemon extract, ...	Nickel Extract, lemon flavor, U. S. Nickel, Phila.	An artificial preparation, giving no reaction for oil of lemon.
Lemon extract, ...	Nickel Lemon for flavoring, etc., U. S. Nickel, 45 S. 2d St., Phila.	An artificial preparation, containing only faint traces of oil of lemon.
Lemon extract, ...	O. K. Lemon flavoring for, etc., The Chas. Hinle Specialty Co., Phila.	An artificial preparation containing traces of oil of lemon.
Maple syrup, ...	Pure Vermont Maple Syrup, D. H. Geer & Son, Boston, Mass.	The low ash indicates that it is not pure sap syrup, adulterated with salicylic acid.
Honey, ...	Fine Delicatessen, A. Weinfield, Phila.	Colored to improve appearance, and heavily adulterated with glucose.
Molasses, ...	April 4, 1902, 12.20 P. M.,	Pure.
Lard, ...	April 4, 1902, 10.35 A. M.,	Pure.
Lard, ...	April 5, 1902, 12.30 P. M.,	Pure.
Honey, ...	Flower Honey, Baders Farm, Schnieder's Genuine, Jenkintown.	Genuine honey.
Lemon extract, ...	Nickel extract with a lemon flavor, U. S. Nickel, Phila.	Bottle broke and sample was lost; replaced by "a 467 " (same brand).
Molasses, ...	April 19, 1902, 11.55 A. M..	Pure.
Maple syrup, ...	Pure Sap Maple Syrup "Compound," Boyle & Williams, Bradford.	Conforms with label.
Maple syrup blend, ..	Goyer's Maple Syrup Blend, guaranteed absolutely wholesome, C. W. Goyer & Co., Memphis, Tenn.	A mixture consisting chiefly of glucose and cane sugar, which may have been derived from the maple.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. H. S. 166,	A. 478,	A. Weinfield,	549 N. 2d St., Phila.,

Pure Food Analyses, May, 1902,

Agent's number and mark.	Chemist's number and mark.	Name.	Address.
	W. 437,	Ralph Bradley,	Stand 76 Pittsburg Market, Pittsburg.
	M. 337,	W. J. Eisler,	Stand 116 Diamond Market, Pittsburg.
	W. 438,	Nicklas Bros.,	Evans City,
	P. 818,	George W. Evans, Jr.,	Stand 113 Diamond Market, Pittsburg.
	P. 815,	W. Welsh,	1618 5th Av., Pittsburg,
	P. 816,	M .M. Fried & Co.,	Stand 28 Diamond Market. Pittsburg.
	W. 440,	Amos Burcher,	Stand 34 Pittsburg Market Pittsburg.
	M. 340,	William Moll,	Stand 13 Diamond Market, Pittsburg.
	W. 441,	McKeesport Provision Co.,	506 5th Av., McKeesport,
	H. 98,	A. Bach,	Jeannette,
	H. 102,	D. T. Knappenberger,	Jeannette,
	H. 101,	Jacobs & Sons,	Jeannette,
	H. 100,	Louis Bauer,	Jeannette,
	H. 99,	J. A. Maxwell,	Jeannette,
	M. 342,	E. A. Reinman,	No. 16 Diamond Mkt., Pittsburg,
	W. 442,	George H. Wehrle, Jr.,	3621 Butler St., Pittsburg,
	P. 820,	M. Gerlach,	1346 Penn Av., Pittsburg,
	M. 345,	George Kress,	Stand 16 Allegheny Market, Allegheny.
	P. 822,	Andrew Lang,	2848 Penn Av., Pittsburg,
	M. 343,	Stenger Bros.,	921 Wylie Av., Pittsburg,
	W. 443,	B. Clocker,	No. 641- 5th Av., Pittsburg,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Honey, ...	Fine Delicatessen, A. Weinfield, Phila.	Probably not pure; not further examined because similar to previous sample of same brand.

F. T. Aschman, Chemist.

Sausage, ...	May 9, 1902, ...	Preserved with sulphites.
Chopped meat, ...	May 9, 1902, ...	Preserved with sulphites.
Lemon extract, ...	Brand: Kitchen Queen, pure extract lemon. Baum Mfg. Co., New Castle.	Contains 3 per cent. of oil of lemon, but is artificially colored.
Chopped beef, ...	May 9, 1902, ...	Not preserved.
Chopped beef, ...	May 10, 1902, ...	Not preserved.
Chopped beef, ...	May 10, 1902, ...	Not preserved.
Chopped beef, ...	May 17, 1902, ...	Not preserved.
Sausage, ...	May 17, 1902, ...	Not preserved.
Sausage, ...	May 22, 1902, ...	Not preserved.
Beef steak, ...	May 22, 1902, ...	Not preserved.
Steak, ...	May 22, 1902, ...	Not preserved.
Steak, ...	May 22, 1902, ...	Not preserved.
Chopped steak, ...	May 22, 1902, ...	Not preserved.
Beef steak, ...	May 22, 1902, ...	Not preserved.
Liver sausage, ...	May 23, 1902, ...	Not preserved.
Liver pudding, ...	May 24, 1902, ...	Not preserved.
Hamburg steak, ...	May 24, 1902, ...	Not preserved.
Beef, ...	May 28, 1902, ...	Not preserved.
Beef, ...	May 28, 1902, ...	Not preserved.
Beef flank, ...	May 28, 1902, ...	Not preserved.
Beef flank, ...	May 28, 1902, ...	Not preserved.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
	W. 444,	M. M. Fried,	Stand 220-28 Pittsburg Market,
	W. 445,	Robert A. Stadleman,	4415 Butler St., Pittsburg,
M. 344,	M. 344,	George Krapf,	Stand 32 Diamond Market,
	P. 821,	G. B. Smith,	1900 Beaver Av., Allegheny,
	M. 341,	A. C. McCune,	413 Market St., McKeesport,

Pure Food Analyses, May, 1902,

Agent's number and mark.	Chemist's number and mark.	Name.	Address.
17,	2538,	Stearns & Gordon Co.,	44 Montgomery St., Jersey City,
1263,	2579,	People's Meat Market,	Sunbury,
1264,	2580,	People's Meat Market,	Sunbury,
1265,	2581,	People's Meat Market,	Sunbury,
1266,	2547,	People's Meat Market,	Sunbury,
1267,	2545,	People's Meat Market,	Sunbury,
1268,	2546,	People's Meat Market,	Sunbury,
18,	2539,	A. R. Edwards,	Colwyn,
	2583,	Dunlevy Bros.,	Pittsburg,
	2582,	Dunlevy Bros.,	Pittsburg,
19 A.,	2556,	Dunlevy Bros.,	Pittsburg,
	2584,	Dunlevy Bros.,	Pittsburg,
	2585,	Dunlevy Bros.,	Pittsburg,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Liver pudding, ...	May 28, 1902, ...	Not preserved.
Hamburg steak, ...	May 28, 1902, ...	Not preserved.
Beef, ...	May 28, 1902, ...	Not preserved.
Beef ribs, ...	May 28, 1902, ...	Not preserved.
Cherry kola, ...	Brand: Cherry Kola Co., Williamsport.	Artificially colored.

C. B. Cochran, Chemist.

Lemon extract, ...	Original sample consists of three small bottles marked A. B. L.; A. terpene; B albumenoid; L. extract.	Sample too small for further examination.
Ham, ...	Coin Special Ham Loaf, C. H. Hammond Co.'s.	Not adulterated.
Veal loaf, ...	Coin Special Veal Loaf, C. N. Hammond Co.'s.	Not adulterated.
Cooked smoked beef,..	Coin Special Cooked Corned Beef, C. N. Hammond Co.'s.	Not adulterated.
Best fresh chuck, ...	May 22, 1902, A. M., ...	Not adulterated.
Mutton chops, ...	May 22, 1902, A. M., ...	Not adulterated.
Beef steak, ...	May 22, 1902, A. M., ...	Not adulterated.
Vanilla extract, ...	Extract of Vanilla, Delaco Extract Co., Colwyn.	An artificial preparation.
Cured sausage (sample "Liel").	....	Colored with a coal tar color, and contains a minute amount of boric acid.
Cured sausage (sample "E").	....	Colored with a coal tar color.
Sausage, ...	Dunlevy's Fresh Beef Sausage.	Sample contains boric acid in rather large quantity.
Cured sausage (sample "H").	....	Colored with a coal tar color.
Cured sausage (sample "Germ").	....	Sample contains boric acid in considerable amount and is colored with a coal tar color.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
19 "M.,"	2555,	Dunlevy Bros.,	Pittsburg,
	2548,	Central Beef Co.,	409 Market St., Harrisburg,
1285,	2577,	Mellot Bros.,	Pottsville,
1284,	2578,	Mellot Bros.,	Pottsville,
1279,	2550,	Mellot Bros.,	Pottsville,
1280,	2551,	Mellot Bros.,	Pottsville,
1281,	2552,	Mellot Bros.,	Pottsville,
1282,	2553,	Mellot Bros.,	Pottsville,
1283,	2554,	Mellot Bros.,	Pottsville,
	2576,	Ross Bros.,	3d and Parker Sts., Chester,

Pure Food Analyses, May, 1902,

J. M. S. 470, L. 539.	A. 485,	George M. Dunlap,	2005 South St., Phila.,
J. M. S. 469, L. 538.	A. 484,	George M. Dunlap,	2005 South St., Phila.,
J. M. S. 466, L. 535.	A. 482,	Robinson & Crawford,	1024 South St., Phila.,
J. M. S. 472, L. 541.	A. 487,	George A. Beh,	809 Girard Av., Phila.,
J. M. S. 471, L. 540.	A. 486,	Wm. Butler,	13th and Girard Av., Phila.,
J. M. S. 476, L. 545.	A. 494,	A. Gartman,	555 N. 2d St., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Sausage,	Dunlevy's Fresh Beef Sausage.	Not adulterated.
Leg of mutton,	....	Not adulterated.
Bologna sausage,	Came from Swift & Co.,	Not adulterated.
Smoked pork sausage,	Came from Swift & Co.,	Not adulterated.
Pork chops,	May 27, 1902, A. M.,	Not adulterated.
Beef (from rump),	Came from Swift & Co.,	Not adulterated.
Beef (from neck),	Came from Swift & Co.,	Not adulterated.
Lamb chops (hind leg).	Came from Swift & Co.,	Not adulterated.
Lamb chops (front quarter).	Came from Swift & Co.,	Not adulterated.
Beef,	From Swift & Co., First and Market Sts., Chester.	Not adulterated.

F. A. Genth, Chemist.

Molasses,	May 3, 1902, 12.05 P. M.,	Chiefly glucose.
Maple syrup,	Pure Vermont Maple Syrup, D. H. Geer & Son, Boston, Mass.	The low ash indicates that the sample is not "sap" syrup, but sugar flavored and contains a salicylic acid.
Maple syrup,	Standard Maple Syrup, strictly pure, put up by the Ameer Preserve Co., Phila.	Ash too low for "maple syrup," probably a high grade syrup flavored or a high grade maple sugar dissolved in water.
Molasses,	May 8, 1902, 12.00 M.,	Compound syrup, chiefly glucose.
Honey,	Durkee's Choice Extracted Clover Honey, J. W. Durkee & Co., N. Y., guaranteed pure honey direct from the bees.	Adulterated with cane sugar.
Honey,	May 9, 1902, 12.05 P. M.,	Chiefly glucose, artificially colored.

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
P. H. S. 173,	A. 490,	A. Eiseman,	605 N. 2d St., Phila.,
J. M. S. 481,	A. 501,	Dennis McGowan,	15th and Sansom Sts., Phila.,
J. M. S. 482,	A. 502,	Kansas City Beef Co.,	2635 Germantown Av., Phila.,
J. M. S. 483,	A. 506,	Keystone Hotel Supply Co.,	12th and Arch St., Phila.,
L. 554,	A. 505,	Butcher shop, J. J. Wilhelm, Prop.	1204 South St., Phila.,
L. 553,	A. 504,	Butcher shop, Jacob Ritchie, Prop.	1224 South St., Phila.,
J. M. S. 474, L. 534.	A. 489,	Majestic Tea Co.,	163 Girard Av., Phila.,
J. M. S. 475, L. 544.	A. 493,	Thos. Hunter,	Ridge Av. and Poplar St., Phila.
P. H. S. 174,	A. 491,	Wm. Butler Co.,	10th and Fairmount Av., Phila.,
L. 551,	A. 499,	B. Rosenberg,	1302 South St., Phila.,
J. M. S. 480,	A. 500,	Ridgway Beef Co.,	2141 Ridge Av., Phila.,
L. 552,	A. 503,	Frank McKerman,	1501 Ridge Av., Phila.,
J. M. S. 484,	A. 507,	Keystone Hotel Supply Co.,	12th and Arch Sts., Phila.,
P. H. S. 178,	A. 497,	Henry Rohner,	5th and Race Sts., Phila.,
J. M. S. 486,	A. 509,	Robinson & Crawford,	4044 Lancaster Av., Phila.,
L. 550.	A. 498,	Hoffman House,	13th and Drury Sts., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Honey,	May 9, 1902, 10.05 A. M.	Not honey, but glucose flavored with honey.
Schemms beer,	Standard, bottled by William Lenck, brewed by Peter Schemm & Son, Phila.	Adulterated with salicylic acid.
Beef brisket,	May 26, 1902, 12.20 P. M.,	Adulterated with sulphites.
Beef,	May 27, 1902, 12.20 P. M.,	Adulterated with boric acid.
Shoulder of mutton,	May 27, 1902, 11.50 A. M.,	Adulterated with sulphurous acid compounds.
Fresh sausage,	May 27, 1902, 11.45 A. M.,	Cereal starches and sulphurous acid was present.
Maple syrup,	Crescent Syrup Lemon, Crescent Preserving Co., Camden, N. J.	Lemon syrup, a mistake in label.
Maple syrup,	Pure Vermont Maple Syrup, strictly pure, The Ameer Preserve Co., Phila.	Pure.
Maple syrup,	Pure Sap Maple Syrup Compound, Boyle & Williams, Bradford.	As represented.
Beef,	May 24, 1902, 12.50 P. M.,	Pure.
Lamb,	May 24, 1902, 11.00 A. M.,	Pure.
Beer,	"Baltz Beer," The J. P. Baltz Brewing Co., Phila.	No salicylic acid present.
Shoulder of mutton,	May 27, 1902, 12.20 P. M.,	Pure.
Raspberry syrup,	C. M. Fruit Syrup, raspberry, Curtis & Moore, Boston, Mass.	Probably pure.
White clover honey,	White Clover Honey, Wm. A. Selser, Jenkintown.	Pure.
Beer,	Tannhauser, The Bergner & Engel Brewing Co., Anthony Kaiser, Phila.	Contains salicylic acid.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
L. 556,	A. 511,	Robinson & Crawford,	1026 South St., Phila.,

Pure Food Analyses, May, 1902,

Agent's number and mark.	Chemist's number and mark.	Name.	Address.
136,	D. 477,	A. J. Mordstom & Co.,	Port Allegany,
F. 503,	D. 479,		
F. 502,	D. 478,		
F. 507,	D. 484,	A. H. Lord,	Altoona,
F. 506,	D. 483,	J. H. Matthews,	Altoona,
3,	363,	J. E. Kerwan,	Main St., Towanda,
4,	358,	George J. Dungan,	Dushore,
8,	362,	G. H. Landon,	Monroeton,
11,	359,	E. E. Strevy,	New Albany,
14,	366,	Bosworth Bros.,	LeRoysville,
15,	361,	E. M. Barley & Son,	LeRoysville,
23,	376,	J. H. Selleck,	Franklindale,
2,	367,	W. F. Deitrich,	Towanda,
6,	371,	T. J. Keeler,	LaPorte,
9,	369,	C. G. Summers & Co.,	Monroeton,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Maple syrup,	Standard Maple Syrup, strictly pure, put up by The Ameer Preserve Co., Phila.	Ash is too low, not genuine maple syrup, apparently a high grade flavored syrup or maple sugar dissolved in water.

Wm. Frear, Chemist.

Mocha and Java coffee.	May 8, 1902, 7.17 A. M.,	Pure.
Formalin,	Solution formaldehyde, 4090, Parke, Davis & Co., Detroit, Mich.	Corresponds to strength on label.
Boric acid,	F. 502,	Pure.
Fresh beef,	Fr. 507, May 26, 1902, 4.30 P. M.	No adulteration found.
Fresh beef,	Fr. 506, May 26, 1902, 4.20 P. M.	No adulteration found.
Vanilla extract,	Acme Extract Co., Binghamton, N. Y.	Not true vanilla extract.
Lemon extract,	Perfect Extract Co., New York.	Not a lemon extract, according to U. S. P.
Vanilla extract,	Brunswick Mfg. Co., N. Y.	Not true vanilla extract.
Vanilla extract,	Perfection Extract Co., N. Y.	Not genuine vanilla extract.
Vienna sausage,	Armour Co.,	Preservative added, borax.
Vanilla extract,	Bear Brand (no address),	Not genuine vanilla extract.
Lemon extract,	Sun Chemical Co., 23 S. Front St., Phila.	Apparently no oil of lemon; not genuine lemon extract.
Maple syrup,	Pure Vermont Maple Sap Syrup, Huntington Maple Syrup and Sugar Co., Huntington, Vt.	Apparently all right.
Ground cinnamon,	F. B. Thrall & Co., Williamsport.	Satisfactory.
Cocoa,	Runkel's Pure Breakfast Cocoa.	Not adulterated.

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
10,	370,	Minard & Grall,	Monroeton,
12,	368,	Smith & Co.,	Wyalusing,
16,	360,	R. J. Cowles & Sons,	Orwell,
19,	372,	N. H. Davis,	Mehoopany,
18,	373,	F. C. Dady,	No. Mehoopany,
17,	374,	W. L. Burgess,	Mehoopany,
20,	375,	J. D. Thornton,	Auburn Centre,
24,	379,	T. H. Selleck,	Franklindale,
20,	2587,	Anna R. Edwards,	Colwyn,
21,	2588,	Sheehan & McEvilla,	Williamsport,
471,	2591,	John A. Chilcote,	Lewistown,
472,	2596,	G. M. Book,	Milroy,
128, A.,	2597,	J. D. Armitage,	Taylor Hotel, Norristown,
129, A.,	2594,	Pennsylvania Hotel,	Chester,
469,	2595,	Samuel Bowman,	211 Chestnut St., Harrisburg,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Mince meat, ...	None Such Mince Meat,	Satisfactory.
Maple syrup, ...	Maple Syrup, Crystal Conserve Co., N. Y.	Sample suspicious.
Vanilla extract, ...	M. M. Fenner, M. D., Fredonia, N. Y.	Satisfactory.
Baking powder, ...	Silver Baking Powder, F. Middleton & Co., Phila.	An alum phosphate baking powder.
Canned oysters, ...	Fresh Cove Oysters, Miller Bros. & Co., Baltimore, Md.	Satisfactory.
Cocoa, ...	American Breakfast Cocoa, Manhattan Cocoa and Chocolate Milk, N. Y.	Satisfactory.
Postum cereal, ...	Postum Cereal, ...	A roasted cereal preparation of good quality.
Cocoa, ...	Ader's Breakfast Cocoa,..	Inferior quality, as compared with other brands, but no case.
Extract of vanilla, ...	Concentrated Extract of Vanilla, Delaco Extract Co., Colwyn.	Not pure extract of vanilla.
Extract of vanilla, ...	Pure Vanilla Extract, Sheehan & McEvilla, groceries, &c.	Article is passible.
Extract of lemon, ...	Saner's Pure Concentrated Extract of Lemon, mfg. by the C. F. Saner Co.	Not adulterated.
Black pepper, ...	Whitman, Schwarz Co., wholesale grocers, Harrisburg, Blue Label Spices.	Sample is low grade, but not adulterated.
Beer, ...	Adam Scheidt Brewing Co.	No adulteration detected.
Beer, ...	June 27, 1902, ...	No adulteration detected.
Tomato catsup, ...	June 5, 1902, ...	Colored and preserved.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses, June, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
A. 517,	A. 517,	S. M. Baer,	Reading,
L. 569, J. M. S. 495.	A. 536,	B. Rosenburg,	1302 South St., Phila.,
J. M. S. 496, L. 570.	A. 537,	B. Rosenburg,	1302 South St., Phila.,
J. M. S. 497,	A. 538,	Frank Reilly,	15th and Vine Sts., Phila.,
571 L., J. M. S. 498.	A. 539,	Chas. Roesch & Sons,	723 Vine St., Phila.,
J. M. S. 507, L. 582.	A. 551,	Shimm & Co.,	131 S. 11th St., Phila.,

Pure Food Analyses, June, 1902,

41,	391,	Frank Meyer,	Mildred,
31,	382,	T. F. Kelley,	Montrose,
25,	378,	H. Norton & Son,	New Albany,
27,	377,	Beckert & Ward,	Alba,
35,	388,	B. S. Clark,	Carbondale,
36,	390,	Martin J. Collins,	Carbondale,
37,	387,	J. H. Pellio,	Honesdale,
30,	383,	N. E. Bissel,	Montrose,

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Chocolate,	Justice Brand Chocolate, Wm. H. Baker, Syracuse.	Adulterated with cornstarch
Beef,	June 13, 1902,	Pure.
Fresh sausage,	June 13, 1902,	Pure.
Bergdolls' beer,	June 13, 1902,	Pure.
Beef and mutton,	June 13, 1902,	Pure.
Ginger ale,	Celebrated Chiquot Club Ginger Ale, Chiquot Club Bottling Extract Co., Millis, Mass.	Contains salicylic acid.

Albert H. Wells, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Vanilla extract,	Paragon Brand, Lewis De Groff Son, 77 and 79 Beach St., N. Y.	Not genuine vanilla extract.
Vanilla extract,	Brunswick Mfg. Co., New York.	Not genuine vanilla extract.
Cream of tartar,	June 2, 1902,	A so called "cream of tartar" substitute.
Lemon extract,	Perfect Extract Co., New York.	Not genuine lemon extract.
Strawberry extract,	Champion Fruit Flavors, strawberry, N. Y. Extract Co., N. Y.	An artificial preparation.
Cream of tartar,	June 18, 1902,	A so called "cream of tartar" substitute.
Lemon extract,	"Concentrated Extract" (no address), "artificially colored" (in large letters on back of bottle).	Not genuine extract, as required by U. S. P.
Strawberry extract,	Superior Strength, Edwin J. Gillies & Co., N. Y.	

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Pure Food Analyses

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
32,	384,	C. P. McKown,	Tunkhannock,
33,	385,	Long & Blackman,	Towanda,
34,	389,	Trexler & Serrell,	Rickets,
39,	394,	S. M. Johnson,	Lopez,
40,	393,	J. P. Gregg,	Lopez,
38,	392,	M .A. Rodgers,	Forksville,

Vinegar Analyses, December, 1901,

M. 295,	M. 295,	Joseph Berringer,	2720 Penn Av., Pittsburg,

Vinegar Analyses, January, 1902,

L. 436, J. M. S. 370.	A. 395,	Donahoe Bros.,	3520 Market St., Phila.,
440 L., J. M. S. 374.	A. 399,	Thomas Hunter,	1624 S. 10th St., Phila.,

Vinegar Analyses, February, 1902,

F. 156,	F. 156,	H. Anderson & Co.,	Ingram.

Vinegar Analyses, February, 1902,

99,	2494,	Kerber & Lutz,	Jenkintown,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

—Continued.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Ginger ale,	Clawson Imperial Ginger Ale, Phila.	Good quality.
Ginger ale,	Imperial Ginger Ale, Francis H. Leggolt & Co., N. Y.	Good quality.
Cream of tartar,	June 17, 1902,	Not adulterated.
Maple syrup,	Monarch Brand, Monarch Maple Syrup Co., Providence, R. I.	No adulteration detected.
Mustard,	No brand or manufacturer's name.	Genuine.
Vienna sausage,	Libby, McNeill & Libby,	Preserved with borax or boracic acid.

F. T. Aschman, Chemist.

Vinegar,	Dec. 13, 1901,	Pure.

F. A. Genth, Chemist.

Cider vinegar,	Jan. 22, 1902,	Acidity, 4.07 per cent.; solids, 3.74 per cent.; ash, 0.29 per cent.
Cider vinegar,	Jan. 28, 1902,	Acidity, 4.18 per cent.; solids, 1.11 per cent.; ash, 0.29 per cent.

F. T. Aschman, Chemist.

Vinegar,	Feb. 25, 1902,	Not pure cider vinegar.

C. B. Cochran, Chemist.

Cider vinegar,	Feb. 10, 1902,	Suspicious.

Vinegar Analyses, February, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
451 L., J. M. S. 358.	A. 418,	Columbia Tea House,	3651 Market St., Phila.,

Vinegar Analyses, March, 1902,

W. 396,	W. 396,	Brand Bros.,	5119 Butler St., Pittsburg,
M. 307,	M. 307,	William Turner,	809 Penn Av., Wilkinsburg,
M. 310,	M. 310,	Geo. S. Daugherty & Co.,	Pike St., Canonsburg,
W. 399,	W. 399,	White Rock Supply Co.,	Store No. 2, Canonsburg,
W. 401,	W. 401,	T. S. Williams,	600 Preble Av., Allegheny,
T. 170,	T. 170,	Antonio Scrafini,	1107 Penn Av., Pittsburg,
M. 316,	M. 316,	H. L. Horn & Bro.,	9 E. Bean St., Washington,
M. 311,	M. 311,	John M. Deen,	523 Rebecca St., Wilkinsburg,
M. 314,	M. 314,	H. J. Beacham,	Cor. Ohio St. and 2d Av., Rankin.
W. 405,	W. 405,	A. W. Glover,	231 2d St., Rankin,
M. 306,	M. 306,	Hornstone & Watson,	4901 Butler St., Pittsburg,

Vinegar Analyses, March, 1902,

1243,	2499,	Lear & Biem,	3d and North Sts., Easton,

Vinegar Analyses, March, 1902,

471 L.,	A. 434,	Turchi Bros.,	843-5 Washington Av.,
493 L., J. M. S. 425.	A. 440,	Joseph W. Ennis,	29th and Stiles Sts., Phila.,
L. 462, J. M. S. 396.	A. 426,	U. S. Naval Home,	Gray's Ferry Road, Phila.,
475 L., J. M. S. 407.	A. 436,	Robinson & Crawford,	21st and Market Sts., Phila.,
497 L., J. M. S. 429.	A. 444,	W. J. Strange,	4435 Frankford Av., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cider vinegar,	Feb. 27, 1902,	Not a completely fermented vinegar; probably apple solids added to low grade vinegar.

F. T. Aschman, Chemist.

Vinegar,	Mar. 13, 1902,	Distilled vinegar, colored.
Vinegar,	Mar. 14, 1902,	Spurious.
Vinegar,	Mar. 20, 1902,	Ash too low, probably watered cider vinegar.
Vinegar,	Mar. 20, 1902,	Distilled vinegar, colored.
Vinegar,	Mar. 21, 1902,	Distilled vinegar, colored.
Vinegar,	Mar. 21, 1902,	Ash too low, sample is watered.
Vinegar,	Mar. 26, 1902,	Distilled vinegar, colored.
Vinegar,	Mar. 24, 1902,	Pure.
Vinegar,	Mar. 25, 1902,	Up to standard.
Vinegar,	Mar. 25, 1902,	According to requirements.
Vinegar,	Mar. 13, 1902,	Has characteristics of pure vinegar.

C. B. Cochran, Chemist.

Vinegar,	Mar. 10, 1902,	Not cider vinegar.

F. A. Genth, Chemist.

Cider vinegar,	Mar. 14, 1902,	Not cider vinegar.
Cider vinegar,	Mar. 24, 1902,	Adulterated with water, ratio about two-thirds vinegar and one-third rain water or distilled water.
Cider vinegar,	Mar. 10, 1902,	Pure.
Cider vinegar,	Mar. 17, 1902,	Probably partly derived from second pressings which would account for the low soluble phosphoric acid.
Cider vinegar,	Mar. 25, 1902,	Pure.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF ANALYSES

Vinegar Analyses, April, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
W. 425,	W .425,	People's Coal Co.,	Monongahela City,
M. 327,	M. 327,	D. S. Gregg,	Cor. Main and Bridge Sts., Monongahela City.
M. 333,	M. 333,	L. S. Dietrich,	208 8th Av., Homestead,
M. 326,	M. 326,	Frank Masnci,	910 Webster Av., Pittsburg,
M. 332,	M. 332,	William Dean,	2178 Center Av., Pittsburg,
W. 433,	W. 433,	Cooper Bros.,	1820 Center Av., Pittsburg,

Vinegar Analyses, April, 1902,

1250,	2536,	H. A. Knause,	Easton,
1251,	2535,	E. M. Arndt,	Easton,

Vinegar Analyses, April, 1902,

461,	D. 471,	Andrew Heisey,	Elizabethtown,
462,	D. 472,	Andrew Heisey,	Elizabethtown,
463,	D. 473,	Andrew Heisey,	Elizabethtown,

Vinegar Analyses, April, 1902,

P. H. S. 168,	A. 479,	Hanscom Bros.,	1311 Market St., Phila.,

Vinegar Analyses, May, 1902,

W. 435,	W. 435,	Peter Fey,	222 6th Av., Homestead,
M. 338,	M. 338,	Evans City Supply Co.,	Evans City, Butler county,
M. 335,	M. 335,	Mrs. M. J. Steele,	234 6th Av., Homestead,
P. 814,	P. 814,	A. A. Goucher & E. E. Christy,	6501 Meadow St., Pittsburg,
W. 439,	W. 439,	L. B. Sharp,	227 Main St., Washington,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Vinegar,	April 14, 1902,	Not pure cider vinegar; probably heavily watered.
Vinegar,	April 14, 1902,	Ash too low, watered.
Vinegar,	April 29, 1902,	Distilled vinegar, colored.
Vinegar,	April 12, 1902,	According to standards.
Vinegar,	April 28, 1902,	According to standards.
Vinegar,	April 28, 1902,	According to standards.

C. B. Cochran, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cider vinegar,	April 16, 1902,	Not cider vinegar.
Pure cider vinegar,	April 17, 1902,	Not cider vinegar.

Wm. Frear, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Vinegar,	April 22, 1902,	Total solids=2.65 per cent.; total acidity=5.14 per cent. acetic acid.
Vinegar,	April 22, 1902,	Total acidity=5.33 per cent.; total solids=2.17 per cent.
Vinegar,	April 22, 1902,	Total acidity=5.06 per cent.; acetic acid; total solids=3.28 per cent.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Malt vinegar,	April 28, 1902,	Not a distilled vinegar, not 4½ per cent., but 3 per cent. strength.

F. T. Aschman, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Vinegar,	May 2, 1902,	Distilled vinegar, colored.
Vinegar,	May 12, 1902,	All constituents too low; watered cider vinegar.
Vinegar,	May 2, 1902,	Solids and ash suspiciously high for the acidity.
Vinegar,	May 8, 1902,	Within requirements.
	May 15, 1902,	Within requirements.

Vinegar Analyses, May, 1902,

Sample.		From Whom Purchased.	
Agent's number and mark.	Chemist's number and mark.	Name.	Address.
536 L., J. M. S. 467.	A. 483,	Robinson & Crawford,	1024 South St., Phila.,
L. 542, J. M. S. 473.	A. 488,	Majestic Tea Co.,	163 Girard Av., Phila.,
P. H. S. 179,	A. 508,	Hanscom's,	1311 Market St., Phila.,

Vinegar Analyses, May, 1902,

1,	365,	George E. Woodruff,	Towanda,
5,	364,	Mrs. M. C. Laner,	LaPorte,

Vinegar Analyses, June, 1902,

468,	2589,	Samuel Bowman,	211 Chestnut St., Harrisburg,
112,	2573,	J. Coulston,	Spring City,

Vinegar Analyses, June, 1902,

29,	381,	J. L. Faurley,	Montrose,
26,	386,	J. B. Cornell,	2108 Ridge Av., Phila.,

OF FOOD, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

F. A. Genth, Chemist.

What Sold For.	Marks on the Package.	Chemist's Statement of the Result of Analyses.
Cider vinegar, ...	May 3, 1902, ...	The low figures for phosphoric acid, especially that present as soluble phosphates, indicate that the article is not the product of apple juice only.
Cider vinegar, ...	May 8, 1902, ...	Not cider vinegar.
Distilled malt vinegar,	May 28, 1902, ...	Partly distilled vinegar having a brown color.

Albert H. Wells, Chemist.

Cider vinegar, ...	May 1, 1902, ...	Satisfactory.
Cider vinegar, ...	May 2, 1902, ...	Deficient in acidity and low in ash.

C. B. Cochran, Chemist.

Cider vinegar, ...	June 5, 1902, ...	Not adulterated.
	June 10, 1902, ...	Probably not cider vinegar.

Albert H. Wells, Chemist.

Cider vinegar, ...	June 11, 1902, ...	Genuine.
Cider vinegar, ...	June 17, 1902, ...	There is no indication, from the chemical examination, that the sample is other than what it is sold for.

PART III.

TABULATED STATEMENT

OF

Suits and Prosecutions

BROUGHT BY

THE DAIRY AND FOOD COMMISSIONER,

FROM

JANUARY 1, 1902, TO JUNE 30, 1902.

ARRANGED BY COUNTIES.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Cheese Case,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
772 P.,	2023	J. S. Holland,	165 Larimer Av., Pittsburg,

Cheese Case,

Agent's number and mark.	Docket number.	Name.	Address.
151,	2115	Thos. Hunter,	S. W. Cor. 6th & Spruce Sts., Phila.,
434 L.,	2168	Thos. Hunter,	19th and Market Sts., Phila.,

Lard Cases,

Agent's number and mark.	Docket number.	Name.	Address.
J. M. S. 361, L. 427.	2080	Kansas City Beef Co.,	1440 S. 8th St., Phila.,
J. M. S. 371, L. 437.	2081	Donahoe Bros.,	3520 Market St., Phila.,
J. M. S. 376, L. 442.	2082	Thomas Hunter,	1624 S. 10th St., Phila.,
J. M. S. 420 L. 448.	2083	John H. Geltz,	2822 Germantown Av., Phila.,
J. M. S. 424, L. 492.	2084	B. Rosenberg,	1320 South St., Phila.,

Lard Case,

Agent's number and mark.	Docket number.	Name.	Address.
S. M. R. 1191,	2056	Jacob Kupsky,	Shenandoah,

Milk Case,

Agent's number and mark.	Docket number.	Name.	Address.
F. 464,	2046	William Cunningham,	Altoona,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Jan. 30, 1902,	Mar. 13, 1902,	Violation Cheese law,	Criminal.

Philadelphia County.

May 28, 1902,	June 3, 1902,	Selling cheese below standard,	Civil.
May 29, 1902,	June 3, 1902.	Cheese not properly marked,	Civil.

Philadelphia County.

April 30, 1902,	May 6, 1902,	Selling compound lard for pure,	Civil.
April 30, 1902,	May 6, 1902,	Selling compound lard for pure,	Civil.
April 30, 1902,	May 6, 1902,	Selling compound lard for pure,	Civil.
April 30, 1902,	May 6, 1902,	Selling compound lard for pure,	Civil.
April 30, 1902.	May 6, 1902,	Selling compound lard for pure,	Civil.

Schuylkill County.

Feb. 4, 1902,	Feb. 4, 1902.	Selling adulterated lard,	Criminal.

Blair County.

March 26, 1902,	....	Selling colored milk,	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Cheese Case

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
772 P.,	2023	J. S. Holland,	James V. McMasters,	Pittsburg,

Cheese Cases,

151,	2115	Thos. Hunter,	Henry R. Stratton,	Philadelphia,
434 L.,	2108	Thos. Hunter,	Henry R. Stratton,	Philadelphia,

Lard Cases,

J. M. S. 361, L. 427.	2080	Kansas City Beef Co.,	Henry R. Stratton,	Philadelphia,
J. M. S. 371, L. 437.	2081	Donahoe Bros.,	Henry R. Stratton,	Philadelphia,
J. M. S. 376, L. 442.	2082	Thomas Hunter,	Henry R. Stratton,	Philadelphia,
J. M. S. 420 L. 448.	2083	John H. Geltz,	Henry R. Stratton,	Philadelphia,
J. M. S. 424, L. 492.	2084	B. Rosenberg,	Henry R. Stratton,	Philadelphia,

Lard Case,

S. M. R. 1191,	2056	Jacob Kupsky,	Richard T. Lewis,	Mahanoy City,

Milk Case,

F. 464,	2046	William Cunningham,	David P. Hart,	Altoona,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Fort Pitt Cream and Produce Co., appeared for deft. and paid fine of $50 and $4.50 costs.	....	Paid.

Philadelphia County—Continued.

Philadelphia County—Continued.

Magistrate fined deft. costs of $8.50.	....	Paid.
Magistrate fined deft. costs of $2.50.	....	Paid.
Continued until May 20, 1902, deft. plead guilty and was fined $25 and $8.50 costs.		
Continued to May 20, 1902, deft. plead guilty and was fined $9 costs.	....	Paid.
Magistrate fined deft. costs only.		

Schuylkill County—Continued.

Deft. plead guilty in court, fined $50 and costs of $10.36.	....	Paid.

Blair County—Continued.

Waived hearing and entered bail for court.	....	

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Milk Case,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
82,	2001	G. Longhead,	Boothwyn,

Milk Case,

Agent's number and mark.	Docket number.	Name.	Address.
S. M. R. 1275, 1277.	2127	W. E. Deihl,	Danville,

Milk Cases,

Agent's number and mark.	Docket number.	Name.	Address.
S. M. R. 1260, 1262.	2125	E. W. Keller,	Sunbury,
S. M. R. 1254,	2126	C. S. Rockfeller,	Sunbury,

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name.	Address.
P. 734,	54	N. Sczykowski,	1019 Sarah St., Pittsburg,
P. 729,	55	F. Goralezyh,	820 Carson St., Pittsburg,
W. 310,	57	Theodore Fritzger,	136 E. Jefferson St., Allegheny,
P. 760,	70	G. F. Young,	3517 Flemming Av., Allegheny,
P. 731,	81	J. Ventz,	2228 Forbes St., Pittsburg,
P. 736,	56	John Holleran,	612 Preble Av., Allegheny,
H. L. B. 228,	137	H. J. Ehrhardt,	135 Market House, Pittsburg,
H. L. B. 169,	61	W. J. Haw,	700 Wylie Av., Pittsburg,
H. L. B. 167,	65	J. P. Sellers,	1398 Fifth Av., McKeesport,
P. 738,	82	Andy Sapper,	183 Cass St., Allegheny,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Delaware County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Feb. 3, 1902,	Feb. 7, 1902,	Selling adulterated milk,	Criminal.

Montour County.

June 26, 1902,	June 27, 1902,	Selling adulterated milk,	Criminal.

Northumberland County.

June 25, 1902,	June 26, 1902,	Selling adulterated milk,	Criminal.
June 25, 1902,	June 26, 1902,	Selling adulterated milk,	Criminal.

Allegheny County.

Jan. 2, 1902,	Jan. 10, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 2, 1902,	Jan. 10, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 2, 1902,	Jan. 10, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 2, 1902,	Jan. 23, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 2, 1902,	Jan. 10, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 2, 1902,	Jan. 10, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 3, 1902,	Feb. 3, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 3, 1902,	Jan. 10, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 3, 1902,	Jan. 10-13, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 7, 1902,	Jan. 14, 1902,	Selling colored “oleo;” no license,	Civil.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Milk Case,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
82,	2001	G. Longhead,	Robert Smith,	Boothwyn,
				Milk Case,
S. M. R. 1275, 1277.	2127	W .E. Deihl,	J. P. Bare,	Danville,
				Milk Cases,
S. M. R. 1260, 1262.	2125	E. W. Keller,	J. P. Carpenter,	Sunbury,
S. M. R. 1254,	2126	C. S. Rockfeller,	J. P. Carpenter,	Sunbury,
				Oleomargarine Cases,
P. 734,	54	N. Sczykowski,	John Groetzinger,	435 Diamond St., Pitts'g,
P. 729,	55	G. Goralezyh,	John Groetzinger,	435 Diamond St., Pitts'g,
W. 310,	57	Theodore Fritzger,	John Groetzinger,	435 Diamond St., Pitts'g,
P. 760,	70	G. F. Young,	John Groetzinger,	435 Diamond St., Pitts'g,
P. 731,	81	J. Ventz,	John Groetzinger,	435 Diamond St., Pitts'g,
P. 736,	56	John Holleran,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 228,	137	H. J. Ehrhardt,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 169,	61	W. J. Haw,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 167,	65	J. P. Sellers,	John Groetzinger,	435 Diamond St., Pitts'g,
P. 738,	82	Andy Sapper,	John Groetzinger,	435 Diamond St., Pitts'g,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Delaware County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Hearing continued; held for court; case continued.		
Montour County—Continued.		
Deft. plead guilty and paid a fine of $50 and $10 annually fee and $1.16 costs.		Paid.
Northumberland County—Continued.		
Deft. plead guilty in both numbers and on information was made out for both and mag. accepted fine of $50 and $10.33 costs.		Paid.
Deft. plead guilty and paid a fine of $50 and $10.33 costs.		Paid.
Allegheny County—Continued.		
Judgment for $100 and costs,		Jan. 13, '02, deft. paid $104.50.
Judgment for $100 and costs,		Paid.
Judgment for $100 and costs,		Paid.
Judgment for $100 and costs,		Paid.
Judgment for $100 and costs.		
Judgment for $100 and costs,	Jan. 15, 1902, appealed to court.	
Judgment for $100 and costs,	Feb. 13, 1902, appealed to court.	
Judgment by default,	Jan. 15, 1902, certioraried to court.	
Judgment for $100 and costs,	Jan. 17, 1902, appealed to court.	
Judgment for $100 and costs,	Jan. 20, 1902, appealed to court.	

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
P. 741,	80	John McGeary,	Fountain and Sandusky Sts., Alleg'y,
H. L. B. 181,	66	B. L. Shoemaker,	Duquesne Av., Duquesne,
H. L. B. 224,	67	Katie Rein,	No. 32 S. S. Market, Pittsburg,
H. L. B. 201,	68	G. A. Schmitt,	805 Penn Av., Wilkinsburg,
H. L. B. 202,	60	W. E. Bunting & Co.,	300 Frankstown Av., Pittsburg,
W. 338,	81	Henry Gerstenschlager,	Brighton Road and Butler Av., Allegheny.
W. 355,	93	J. Aughinbaugh,	No. 1 Charles St., Allegheny,
W. 359,	94	Samuel C. Garvin,	12 Lombard St., Allegheny,
W. 334,	95	Mrs. Mary and John Yanoseik,	8 Benton Av., Allegheny,
W. 337,	92	D. Waldschmidt,	Stand 138 Mkt. House, Allegheny,
H. L. B. 171,	112	J. B. Imhoff,	62 Frankstown Av., Pittsburg,
H. L .B. 209,	114	Corcoran & Booth,	107 Third Av., Pittsburg,
H. L. B. 176,	123	P. M. Corrigan,	1905 Penn Av., Pittsburg,
H. L. B. 227,	138	Patrick Linaugh,	5022 Penn Av., Pittsburg,
P. 727,	140	R .Lowenstein,	74 Frankstown Av., Pittsburg,
H. L. B. 204	101	Dan Jordan,	21 Diamond Market,
H. L. B. 198,	102	A. J. McQuiggan,	552 Braddock Av., Braddock,
H. L. B. 196,	103	S. A. McCutcheon,	819 Wood St., Wilkinsburg,
H. L. B. 207,	104	Owen McCann,	410 Market St., Pittsburg,
H. L. B. 206,	105	T. S. Flynn,	635 33d St., Pittsburg,
H. L. B. 189,	107	S. G. Shoop,	1201 Federal St., Allegheny,
H. L. B. 184,	108	Mary Smith,	2230 Fifth Av., Pittsburg,
H. L. B. 190,	109	H. Watson,	196 Main St., W. E., Pittsburg,
H. L. B. 193,	110	John M. Deen,	525 Rebecca St., Wilkinsburg,
H. L. B. 208,	113	Owen McCann,	401-403 Market St., Pittsburg,
H. L. B. 212,	115	John G. Messner,	415 Market St., Pittsburg,
H. L. B. 215,	118	A. Braun,	167-169 Market House, Allegheny,
H. L. B. 214,	117	J. J. Anthony,	121 East Ohio St., Allegheny,
H. L. B. 183,	120	Harper & Wynne,	1734 Fifth Av., Pittsburg,
H. L. B. 178,	121	N. Huber,	215 Wylie Av., Pittsburg,
H. L. B. 177,	122	B. M. Quinn,	845 Braddock Av., Braddock,
H. L. B. 174,	124	S. B. Charters,	Cor. Grant and 3d Av.,
H. L. B. 217,	125	J. J. Anthony,	18 Diamond Square, Pittsburg,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Jan. 7, 1902,	Jan. 14, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 8, 1902,	Jan. 15, 1902,	Selling colored “oleo,” no stamps,	Civil.
Jan. 8, 1902,	Jan. 15, 1902,	Selling colored “oleo,”	Civil.
Jan. 8, 1902,	Jan. 15, 1902,	Selling colored “oleo,”	Civil.
Jan. 8, 1902,	Jan. 15, 1902,	Selling colored “oleo;” no stamp,	Civil.
Jan. 17, 1902,	Jan. 27, 1902,	Selling colored “oleo;” no license; no stamp,	Civil.
Jan. 17, 1902,	Jan. 27, 1902,	Selling colored oleo; no license,	Civil.
Jan. 17, 1902,	Feb. 7, 1902,	Selling colored oleo; no license,	Civil.
Jan. 17, 1902,	Jan. 27, 1902,	Selling colored “oleo;” no license,	Civil.
Jan. 30, 1902,	Feb. 7, 1902,	Selling colored “oleo:” no license,	Civil.
Jan. 30, 1902,	Feb. 7, 1902,	Selling “oleo” colored in imitation of yellow butter.	Civil.
Jan. 30, 1902,	Feb. 7, 1902,	Selling colored “oleo,”	Civil.
Feb. 20, 1902,	Feb. 28, 1902,	Selling colored “oleo;” no stamp; no license,	Civil.
Feb. 20, 1902,	Feb. 28, 1902,	Selling colored “oleo;” no stamps; no license,	Civil.
Feb. 20, 1902,	Feb. 26, 1902,	Selling colored “oleo;” no stamps	Civil.
Feb. 25, 1902,	March 10, 1902,	Selling colored “oleo;” no stamps,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo;” no stamps,	Civil.
Feb. 25, 1902.	March 5, 1902,	Selling colored “oleo;” no stamps,	Civil.
Feb. 25, 1902,	March 5, 1902,	Selling colored “oleo;” no stamps,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo;” no stamps,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo,”	Civil.
Feb. 25, 1902,	March 5, 1902,	Selling colored “oleo,”	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo,”	Civil.
Feb. 25, 1902,	March 5, 1902,	Selling colored “oleo;” no stamp,	Civil.
Feb. 25, 1902,	March 5, 1902.	Selling colored “oleo,”	Civil.
Feb. 25, 1902,	March 5, 1902,	Selling colored “oleo,”	Civil.
Feb. 25, 1902,	March 7, 1902,	Selling colored “oleo;” no stamp,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo;” no stamps,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo” for butter,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo” for butter,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo” for butter,	Civil.
Feb. 25, 1902,	March 5, 1902,	Selling colored “oleo;” no stamp,	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored “oleo;” no stamp,	Civil.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
P. 741,	80	John McGeary,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 181,	66	B. L. Shoemaker,	John Groetzinger,	435 Diamond St., Pitts'g
H. L. B. 224,	67	Katie Rein,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 201,	68	G. A. Schmitt,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 02,	69	W. E. Bunting & Co.,	John Groetzinger,	435 Diamond St., Pitts'g,
W. 338,	84	Henry Gertenschlager,	John Groetzinger,	435 Diamond St., Pitts'g,
W. 355,	93	J. Aughinbaugh,	John Groetzinger,	435 Diamond St., Pitts'g,
W. 359,	94	Samuel C. Garvin,	John Groetzinger,	435 Diamond St., Pitts'g,
W. 334,	95	Mrs. Mary and John Yanoseik.	John Groetzinger,	435 Diamond St., Pitts'g,
W. 337,	92	D. Waldschmidt,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 171,	112	J. B. Imhoff,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 209,	114	Corcoran & Booth,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 176,	123	P. M. Corrigan,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 227,	138	Patrick Linaugh,	John Groetzinger,	435 Diamond St., Pitts'g,
P. 727,	140	R. Lowenstein,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 204	101	Dan. Jordan,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 198,	102	A. J. McQuiggan,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 196,	103	S. A. McCutcheon,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 207,	104	Owen McCann,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 206,	105	T. S. Flynn,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 189,	107	S. G. Shoop,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 184,	108	Mary Smith,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 190,	109	H. Watson,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 193,	110	John M. Deen,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 208,	113	Owen McCann,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 212,	115	John G. Messner,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 215,	118	A. Braun,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 214,	117	J. J. Anthony,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 183,	120	Harper & Wynne,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 178,	121	N. Huber,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 177,	122	B. M. Quinn,	John Groetzinger,	435 Diamond St., Pitts'g
H. L. B. 174,	124	S. B. Charters,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 217,	125	J. J. Anthony,	John Groetzinger,	435 Diamond St., Pitts'g,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Judgment for $100 and costs, ...	Jan. 20, '02, upon payment of costs.	
Judgment for $100 and costs, ...	Jan. 22, '02, app'led to court.	
Judgment for $100 and costs, ...	Jan. 22, '02, app'led to court.	
Judgment for $100 and costs, ...	Feb. 3, '02, app'led to court.	
Judgment for $100 and costs, ...	Jan. 21, '02, app'led to court.	
Judgment for $100 and costs, ...	Feb. 1, '02, app'led to court.	
Judgment for $100 and costs, ...	Feb. 8, '02, app'led to court.	
Judgment for $100 and costs, ...	Feb. 24, '02, app'led to court.	
Judgment for $100 and costs, ...	Feb. 10, '02, app'led to court.	
Judgment for $100 and costs, ...	Feb. 27, '02, certoraried to court.	
Judgment for $100 and costs, ...	Feb. 13, '02 app'led to court.	
Judgment for $100 and costs, ...	Feb. 14, '02, app'led to court.	
Judgment for $100 and costs, ...	Feb. 7, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 12, '02, app'led to court.	
Judgment for $100 and costs, ...		
Judgment for $100 and costs, ...	Mar. 7, '02, certioraried to court.	
Judgment for $100 and costs, ...	Mar. 15, '02, app.led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 10, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 10, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 10, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 10, '02, app'led to court.	
Judgment for defendant, ...		
Judgment for $100 and costs, ...	Mar. 5, '02, app'led to court.	
Judgment for $100 and costs, ...		
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 12, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
H. L. B. 225,	129	B. Krupp,	51 S. 12th St., S. S., Pittsburg,
H. L. B. 231,	135	A. L. Ritchey,	436 Market St., Pittsburg,
H. L. B. 205,	106	F. A. Hawley,	516 Fifth Av., McKeesport,
H. L. B. 195,	111	Louis Nease,	201 Main St., W. E., Pittsburg,
H. L. B. 213,	116	Sheehan & Cavanaugh,	313 Market St., Pittsburg,
H. L. B. 219,	126	F. J. Fuher,	18 Diamond Market, Pittsburg,
H. L. B. 223,	128	A. Appel, Jr.,	41 Market House, S. S., Pittsburg,
F. 1,	180	Holland Butterine Co.,	518-26 First Av., Pittsburg,
F. 2,	181	Holland Butterine Co.,	518-26 First Av., Pittsburg,
H. L. B. 243,	99	W. M. Swindler,	434 Market St., Pittsburg,
H. L. B. 216,	119	Stenger Bros.,	921 Wylie Av., Pittsburg,
H. L. B. 222,	127	John A. Schrader,	14 Diamond Mkt., Pittsburg,
H. L. B. 235,	130	Adam Weitzel,	99 Washington Av., Pittsburg,
H. L. B. 236,	131	J. E. Gibson,	197 Market House, Allegheny,
H. L. B. 238,	132	J. W. Saunders,	91 Chartiers Av., McKees Rocks,
H. L. B. 233,	133	Charles G. Hoover,	93 Market House, Allegheny,
H. L. B. 234	134	W. H. Speaker,	15 Wabash Av., W. E., Pittsburg
H. L. B. 237,	179	Ed. J. Rauch,	103 Southern Av., Knoxville,
R. for M. 1,	173	W. J. Moxley,	407 Ferry St., Pittsburg,
R. for M. 2,	174	Holland Butterine Co.,	518-26 First Av., Pittsburg,
R. for M. 3,	175	Owen McCann,	401-3 Market St., Pittsburg,
T. 120,	182	W. J. Haw,	700 Wylie Av., Pittsburg,
T. 121,	183	G. H. Callahan,	Main and Liberty Sts., Braddock,
T. 122,	184	James L. O'Donnell,	64 Washington Av., S. S., Pittsburg.
T. 126,	185	Mrs. E. Logan,	5913 Penn Av., Pittsburg,
T. 127,	186	Bernard Altvaler,	1000 Rebecca St., Allegheny,
T. 128,	187	H. F. Levi,	1620 Beaver Av., Allegheny,
T. 130,	188	Evan Thomas,	656 Preble Av., Allegheny,
T. 134,	189	Mrs. Mary Smith,	2230 Fifth Av., Pittsburg,
T. 135,	190	F .E. Preach,	2136 Fifth Av., Pittsburg,
T. 137,	191	J. H. Schmitt,	4114 Penn Av., Pittsburg,
T. 138,	192	H. Watson,	196 Main St., W. E., Pittsburg,
T. 140,	193	J. P Leonard,	1700 Fifth Av., Pittsburg,
T. 142,	194	W. E. Bunting & J. W. Furgeson,	300 Frankstown, Pittsburg,
T. 147,	195	G. H. Mooney,	9 Grant Av., Millvale,
T. 154,	196	Adam Weitzel,	99 Washington Av., S. S., Pittsburg,
T. 158,	197	H. McCambridge,	600 Herron Av., Pittsburg,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Feb. 25, 1902,	March 28, 1902,	Selling colored "oleo,"	Civil.
Feb. 25, 1902,	March 6, 1902,	Selling colored "oleo,"	Civil.
Feb. 25, 1902,	March 7, 1902,	Selling colored "oleo,"	Civil.
Feb. 28, 1902,	March 7, 1902,	Selling colored "oleo,"	Civil.
Feb. 28, 1902,	March 7, 1902,	Selling colored "oleo;" no stamp,	Civil.
Feb. 28, 1902,	March 7, 1902,	Selling colored "oleo;" no stamps,	Civil.
Feb. 28, 1902,	March 7, 1902,	Selling colored "oleo;" no stamp,	Civil.
Feb. 28, 1902,	March 7, 1902,	Selling colored "oleo" in imitation of yellow butter.	Civil.
Feb. 28, 1902,	March 7, 1902,	Selling colored "oleo,"	Civil.
Feb. 28, 1902,	March 10, 1902,	Selling colored "oleo,"	Civil.
March 4, 1902,	March 10, 1902,	Selling colored "oleo;" no stamps,	Civil.
March 4, 1902,	March 10, 1902,	Selling colored "oleo;" no stamps,	Civil.
March 4, 1902,	March 10, 1902,	Selling colored "oleo,"	Civil.
March 4, 1902,	March 10, 1902,	Selling colored "oleo,"	Civil.
March 4, 1902,	March 10, 1902,	Selling colored "oleo,"	Civil.
March 4, 1902,	March 10, 1902,	Selling colored "oleo,"	Civil.
March 4, 1902,	March 10, 1902,	Selling colored "oleo;" no stamp,	Civil.
March 4, 1902,	March 20, 1902,	Selling colored "oleo;" no stamp,	Civil.
March 4, 1902,	March 28, 1902,	Selling colored "oleo,"	Civil.
March 22, 1902,	March 28, 1902,	Selling colored "oleo,"	Civil.
March 22, 1902,	March 28, 1902,	Selling colored "oleo,"	Civil.
March 22, 1902,	April 21, 1902,	Selling colored "oleo;" no license,	Civil.
April 15, 1902,	April 21, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 21, 1902.	Selling colored "oleo,"	Civil.
April 15, 1902,	April 21, 1902.	Selling colored "oleo,"	Civil.
April 15, 1902,	April 21, 1902,	Selling colored "oleo;" no license; no stamp,	Civil
April 15, 1902,	April 21, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 21, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 21, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 23, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 21, 1902,	Selling colored "oleo;" no license; no stamps,	Civil.
April 15, 1902,	April 23, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 23, 1902,	Selling colored "oleo;" no license; no cards,	Civil.
April 15, 1902,	April 23, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 23, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 23, 1902,	Selling colored "oleo,"	Civil.
April 15, 1902,	April 23, 1902,	Selling colored "oleo;" no stamp,	Civil.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
H. L. B. 225,	129	B. Krupp,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 231,	135	A. L. Ritchey,	John Groetzinger,	435 Diamond St., Pitts'g.
H. L. B. 205,	106	F. A. Hawley,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 195,	111	Louis Nease,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 213,	116	Sheehan Cavanaugh,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 219,	126	F .J. Fuher,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 223,	128	A. Appel, Jr.,	John Groetzinger,	435 Diamond St., Pitts'g,
F. 1,	180	Holland Butterine Co.,	John Groetzinger,	435 Diamond St., Pitts'g.
F. 2,	181	Holland Butterine Co.,	John Groetzinger,	435 Diamond St., Pitts'g.
H. L. B. 243,	99	W. M. Swindler,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 216,	119	Stenger Bros.,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 222,	127	John A. Schrader,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 235,	130	Adam Weitzel,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 236,	131	J. E. Gibson,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 238,	132	J. W. Saunders,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 233,	133	Charles G. Hoover,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 234	134	W. H. Speaker,	John Groetzinger,	435 Diamond St., Pitts'g,
H. L. B. 237,	179	Ed. J. Rauch,	John Groetzinger,	435 Diamond St., Pitts'g,
R. for M. 1,	173	W. J. Moxley,	John Groetzinger,	435 Diamond St., Pitts'g,
R. for M. 2,	174	Holland Butterine Co.,	John Groetzinger,	435 Diamond St., Pitts'g,
R. for M. 3,	175	Owen McCann,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 120,	182	W. J. Haw,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 121,	183	G. H. Callahan,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 122,	184	James L. O'Donnell,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 126,	185	Mrs. E. Logan,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 127,	186	Bernard Altvaler,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 128,	187	H. F. Levi,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 130,	188	Evan Thomas,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 134,	189	Mrs. Mary Smith,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 135,	190	F. E. Preach,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 137,	191	J. H. Schmitt,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 138,	192	H. Watson,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 140,	193	J. P. Leonard,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 142,	194	W. E. Bunting & J. W. Furgeson,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 147,	195	G. H. Mooney,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 154,	196	Adam Weitzel,	John Groetzinger,	435 Diamond St., Pitts'g,
T. 158,	197	H. McCambridge,	John Groetzinger,	435 Diamond St., Pitts'g,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Judgment for $100 and costs, ...		
Judgment for $100 and costs, ...	Mar. 7, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 12, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 15, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 15, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 15, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 11, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 15, '02, app'led to court.	
Judgment for $100 and costs, ...	Mar. 15, '02, app'led to court.	
Judgment for $100 and costs.	Mar. 15, '02, app'led to court.	
Judgment for $100 and costs.	Mar. 11, '02, app'led to court	
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs,		
Judgment for $100 and costs.		
Judgment for $100 and costs, ...	May 1, '02, app'led to court.	
Judgment for $100 and costs.		
Judgment for $100 and costs, ...	May 1, '02, app'led to court.	
Judgment for $100 and costs.		
Judgment for $100 and costs, ...	May 2, '02, certioraried.	
Judgment for $100 and costs, ...	April 28, '02, certioraried.	
Judgment for $100 and costs, ...	May 1, '02, app'led to court.	
Judgment for $100 and costs, ...	May 2, '02, app'led to court.	
Judgment for $100 and costs.	Apr. 28, '02, app'led to court.	

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
W. 340,	207	Herman Aupke,	Brighton Road near Jackson Run Allegheny county.
P. 763,	208	Joseph Miller (restaurant),	68 Frankstown Av., Pittsburg,
P. 784,	209	J. A. Wilt,	25 Carver St .,E. E., Pittsburg,
W. 311,	210	Gus Kaut,	916 Walnut St., McKeesport,
P. 725,	215	A. Kimelman,	1100 Soles St., McKeesport,
P. 742,	216	Wm. Schnellbacker,	20 California Av., Allegheny,
W. 381,	217	Jacob Raab,	10 Mead St., Allegheny,
W. 345,	220	W. H. Randolph,	1814 Beaver Av., Allegheny,
M. 305,	221	H. L. Kelley,	5205 Butler St., Pittsburg,
W. 346,	222	Geo. S. Daugherty & Co.,	1205 Carson St., Pittsburg,
W. 388,	241	Frank Cominski,	2832 Penn Av., Pittsburg,

Oleomargarine Cases,

W. A. H. 21,	88	Thomas Baldridge,	Apollo,
W. A. H. 23,	89	J. M. Gremm,	Apollo,
McG. 76,	223	Fred. Meyers,	Kittanning,

Oleomargarine Cases,

W. A. H. 50	151	J. W. Vandervort,	Rochester,
W. A. H. 39,	152	J. E. Ewing of Ewing Bros.,	Beaver Falls,
W. A. H. 38,	153	Joseph McFerron,	Beaver Falls,
W. A. H. 61,	201	Joseph McFerron,	Beaver Falls,
W. A. H. 62,	202	Ewing Bros.,	Beaver Falls,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
April 30, 1902,	May 7, 1902,	Selling colored "oleo,"	Civil.
April 30, 1902,	May 7, 1902,	Selling colored "oleo;" no license,	Civil.
April 30, 1902,	May 7, 1902,	Selling colored "oleo;" no cards, stamps or license.	Civil.
April 30, 1902,	May 7, 1902,	Selling colored "oleo;" no cards, stamps or license.	Civil.
May 14, 1902,	May 23, 1902,	Selling colored "oleo;" no cards; stamps or license.	Civil.
May 14, 1902;	May 23, 1902,	Selling colored "oleo;" no cards, stamps or license.	Civil.
May 14, 1902,	May 23, 1902,	Selling colored "oleo;" no cards, stamps or license.	Civil.
May 29, 1902,	June 5, 1902,	Selling colored "oleo,"	Civil.
May 29, 1902,	June 5, 1902,	Selling colored "oleo;" no license,	Civil.
May 29, 1902,	June 5, 1902,	Selling colored "oleo;" not stamped,	Civil.
June 30, 1902,	July 7, 1902,	Selling colored "oleo;" no stamps; no license,..	Civil.

Armstrong County.

Feb. 11, 1902,	Feb. 20, 1902,	Violation of "oleo" laws,	Criminal.
Feb. 11, 1902,	Feb. 20, 1902,	Violation of "oleo" laws,	Criminal.
May 29, 1902,	June 4, 1902,	Selling colored "oleo,"	Criminal

Beaver County.

March 12, 1902,	March 21, 1902,	Selling colored "oleo,"	Criminal.
March 12, 1902,	March 21, 1902,	Selling colored "oleo,"	Civil.
March 12, 1902,	March 21, 1902,	Selling colored "oleo,"	Civil.
April 25, 1902,	May 5, 1902,	Selling colored "oleo,"	Civil.
April 25, 1902,	May 5, 1902,	Selling colored "oleo,"	Civil.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
W. 340, ...	207	Herman Aupke, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,
P. 763, ...	208	Joseph Miller (resta't),	John Groetzinger, ...	435 Diamond St., Pitts'g,
P. 784, ...	209	J. A. Wilt, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,
W. 311, ...	210	Gus Kaut, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,
P. 725, ...	215	A. Kimelman, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,
P. 742, ...	216	Wm. Schnellbacker, ..	John Groetzinger, ...	435 Diamond St., Pitts'g,
W. 381, ...	217	Jacob Raab, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,
W. 345, ...	220	W. H. Randolph, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,
M. 305, ...	221	H. L. Kelley, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,
W. 346, ...	222	Geo. S. Daugherty & Co.	John Groetzinger, ...	435 Diamond St., Pitts'g,
W. 388, ...	241	Frank Cominski, ...	John Groetzinger, ...	435 Diamond St., Pitts'g,

Oleomargarine Cases,

W. A. H. 21,	88	Thomas Baldridge, ...	William Brown, ...	Kittanning, ...
W. A. H. 23,	89	J. M. Gremm, ...	William Brown, ...	Kittanning, ...
McG. 76, ...	223	Fred. Meyers, ...	Joel Crawford, ...	Kittanning, ...

Oleomargarine Cases,

W. A. H. 50	151	J. W. Vandervort, ...	Stephen Minor, ...	Beaver, ...
W. A. H. 39,	152	J. E. Ewing of Ewing Bros.	Stephen Minor, ...	Beaver, ...
W. A. H. 38,	153	Joseph McFerron, ...	Stephen Minor, ...	Beaver, ...
W. A. H. 61,	201	Joseph McFerron, ...	Stephen Minor, ...	Beaver, ...
W. A. H. 62,	202	Ewing Bros., ...	Stephen Minor, ...	Beaver, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Allegheny County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs; continued to May 29, 1902.		
Judgment for $100 and costs; continued to May 29, 1902.	June 8, '02, app'led to court.	
Judgment for $100 and costs; continued to May 29, 1902.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		
Armstrong County—Continued.		
Waived hearing; continued until March 4, 1902; plead guilty, fined $100 and costs.	....	Paid.
Waived hearing; continued until March 4, 1902; plead guilty, fined $100 and costs.	....	Paid.
Held for court, ...	Found true bill; June 4, 1902, case continued.	
Beaver County—Continued.		
May 5, 1902; deft. entered bail for court.		
Judgment for $100 and costs.		
Judgment for $100 and costs.		

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
F. 499,	219	Benj. Reese,	Johnstown,

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name.	Address.
S. M. R. 1214,	77	Annie Swartz,	Lehighton,
S. M. R. 1213,	78	Chas. Sponheimer,	Lehighton,
S. M. R. 1212,	79	Henry Mearhoff and Wm. Oswald,	Lehighton,

Oleomargarine Case,

Agent's number and mark.	Docket number.	Name.	Address.
F. 497,	218	J. C. Bears,	Blaine City,

Oleomargarine Case,

Agent's number and mark.	Docket number.	Name.	Address.
18,	225	Sensor & Beals,	Meadville,

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name.	Address.
McG. 70,	159	O. H. Shoemaker,	Uniontown,
McG. 71,	162	O. H. Shoemaker,	Connellsville,

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name.	Address.
M. 272,	96	W. H. Lippincott,	Waynesburg,
W. 366,	98	G. W. Geoyne,	Hotel "Walton,"

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Cambria County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
May 16, 1902,	May 23, 1902,	Selling colored "oleo,"	Criminal.

Carbon County.

Jan. 14, 1902,	Jan. 14, 1902,	Selling colored "oleo" as butter,	Criminal.
Jan. 14, 1902,	Jan. 14, 1902,	Selling "oleo" for butter,	Criminal.
Jan. 14, 1902,	Jan. 14, 1902,	Selling "oleo" retail and wholesale,	Criminal.

Clearfield County.

May 13, 1902,		Selling "oleo;" no stamp, no license,	Criminal.

Crawford County.

May 21, 1902,	June 6, 1902,	Selling colored "oleo;" no stamps; no license,	Civil.

Fayette County.

March 10, 1902,	March 13, 1902,	Selling colored "oleo,"	Civil.
March 11, 1902,	March 13, 1902,	Selling colored "oleo,"	Civil.

Greene County.

March 11, 1902,	March 18, 1902,	Selling colored "oleo,"	Criminal.
March 11, 1902,	March 18, 1902,	Selling "oleo;" no signs; no license,	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
F. 499, ...	219	Benj. Reese, ...	John A. Jones, ...	Johnstown, ...

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
S. M. R. 1214,	77.	Annie Swartz, ...	H. A. Beltz, ...	Lehighton, ...
S. M. R. 1213,	78	Chas. Sponheimer, ...	H. A. Beltz, ...	Lehighton, ...
S. M. R. 1212,	79	Henry Mearhoff & Wm. Oswald.	H. A. Beltz, ...	Lehighton, ...

Oleomargarine Case,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
F. 497, ...	218	J. C. Bears, ...	P. Gallagher, ...	Osceola, ...

Oleomargarine Case,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
18, ...	225	Sensor & Beals, ...	D. L. Lockart, ...	Meadville, ...

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
McG. 70, ...	159	O. H. Shoemaker, ...	John N. Dawson, ...	Uniontown, ...
McG. 71, ...	162	O. H. Shoemaker, ...	John N. Dawson, ...	Uniontown, ...

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
M. 272, ...	36	W. H. Lippincott, ...	G. W. Ullom, ...	Waynesburg, ...
W. 366, ...	38	G. W. Geoyne, ...	G. W. Ullom, ...	Waynesburg, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Cambria County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Deft. bound over to court.		

Carbon County—Continued.

Held deft. in $300 bail for court,.	April 15, defdt. acquitted; county pay costs.	Paid.
Held deft. in $300 bail for court,.	Plead guilty and paid fine of $100 and costs.	Paid.
Mearhoff was committed to jail for April term of court; held Oswald in $300 bail for court.	April 15, sentence suspended upon payment of costs.	Paid.

Clearfield County—Continued.

Waived hearing and entered bail for court.		

Crawford County—Continued.

Deft. confessed judgment, paid fine of $100 and costs.		Paid.

Fayette County—Continued.

Deft. appeared, confessed judgment for $100 and costs.		Paid.
Deft. appeared, confessed judgment for $100 and costs.		Paid.

Greene County—Continued.

March 18, waived hearing and entered bail for court.		
Waived hearing and entered bail for court.		

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
134,	85	H. B. Sweet,	Scranton,
188,	226	Lewis Sbrocca,	141 Robinson St., Scranton,
186,	227	Fred. Hugg,	Scranton,
183,	228	John Pinko,	Second St., Scranton,
180,	229	T. W. Bastowiski,	Minooka,
179,	230	Michael Yuhas,	Scranton,
175,	232	Wm. P. Joyce,	Scranton,
H. L. B. 262,	235	H .D. Sweet,	Scranton,
S. J. S. 178,	236	Henry Mellet,	Scranton,
177, *	231	H. D. Sweet,	Penn Av., Scranton,

Oleomargarine Case,

129,	213	Harry Dorman,	Williamsport,

Oleomargarine Case,

132,	211	John Johnson,	Bradford,

Oleomargarine Cases,

W. A. H. 48	148	Jacob & Frank Gross,	South Sharon,
W. A. H. 59,	157	Henry Baldwin,	Sharon,
W. A. H. 58,	158	Jacob & Frank Gross,	South Sharon,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Lackawanna county.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Feb. 1, 1902,	Feb. 7, 1902,	Selling "oleo;" no license,	Civil.
May 29, 1902,	June 4, 1902,	Selling colored "oleo,"	Criminal.
May 29, 1902,	June 4, 1902,	Selling colored "oleo;" no license,	Civil.
May 29, 1902,	June 4, 1902,	Selling colored "oleo;" no license,	Civil.
May 29, 1902,	June 4, 1902,	Selling colored "oleo;" no license,	Civil.
May 29, 1902,	June 4, 1902,	Selling colored "oleo;" no license,	Civil.
May 29, 1902,	June 4, 1902,	Selling colored "oleo;" no license,	Civil.
May 31, 1902,	June 13, 1902,	Selling "oleo;" no license,	Civil.
May 26, 1902,	June 13, 1902,	Selling "oleo;" no license,	Civil.
June 4, 1902,	June 13, 1902,	Selling colored "oleo;" no license,	Criminal.

Lycoming County.

April 7, 1902,	April 8, 1902,	Selling colored "oleo,"	Criminal.

McKean County.

April 22, 1902,	April 24, 1902,	Selling "oleo,"	Criminal.

Mercer County.

March 11, 1902,	March 22, 1902,	Selling colored "oleo,"	Civil.
March 11, 1902,	March 22, 1902,	Selling colored "oleo,"	Civil.
March 11, 1902,	March 22, 1902,	Selling colored "oleo,"	Civil.

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
134, ...	85	H. B. Sweet, ...	M. Kasson, ...	Scranton, ...
188, ...	226	Lewis Sbrocca, ...	M. Kasson, ...	Scranton, ...
186, ...	227	Fred. Hugg, ...	M. Kasson, ...	Scranton.
183, ...	228	John Pinko, ...	M. Kasson, ...	Scranton.
180, ...	229	T. W. Bastowiski, ...	M. Kasson, ...	Scranton.
179, ...	230	Michael Yuhas, ...	M. Kasson, ...	Scranton.
175, ...	232	Wm. P. Joyce, ...	M. Kasson, ...	Scranton, ...
H. L. B. 262,	235	H. D. Sweet, ...	M. Kasson, ...	Scranton, ...
S. J. S. 178,	236	Henry Mellet, ...	M. Kasson, ...	Scranton, ...
177, ...*......	231	H. D. Sweet, ...	M. Kasson, ...	Scranton, ...

Oleomargarine Case,

129, ...	213	Harry Dorman, ...	H. C. Kellenback, ...	Williamsport, ...

Oleomargarine Case,

132, ...	211	John Johnson, ...	B. L. Knapp, ...	Smithport, ...

Oleomargarine Cases,

W. A. H. 48	148	Jacob & Frank Gross,	Thomas Thomas, ...	Sharon, ...
W. A. H. 59,	157	Henry Baldwin, ...	Thomas Thomas, ...	Sharon, ...
W. A. H. 58,	158	Jacob & Frank Gross,	Thomas Thomas, ...	Sharon, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Lackawanna County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Gave judgment for fine and costs.	Appealed to court.	
Deft. gave bail for appearance at court.		
Judgment for Commonwealth.		
Judgment rendered against deft., who took an appeal; appeal taken too late; judgment by default.		
Judgment rendered against defendant.		
Deft. gave bail for appearance at court.		

Lycoming County—Continued.

Held deft. for June term of court; $100 bail.	Defdt. plead guilty and fined $100 and costs.	Paid.

McKean County—Continued.

Held for court; $300 bail.		

Mercer County—Continued.

Deft. plead guilty and paid costs of $4.56.		
Judgment given for $100 and costs.	....	Paid.
Deft. plead guilty and paid fine of $100 and costs.	....	Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
W. A. H. 57,	147	J. J. Nolan,	South Sharon,
W. A. H. 47,	149	M. Hirst,	Sharon,
W. A. H. 46,	150	Henri Hoelzel,	Sharon,
224,	16	John J. Heinbacker,	South Sharon,

Oleomargarine Cases,

W. A. H. 26,	141	W. J. Hartzel,	New Castle,
W. A. H. 28,	146	C. E. Thomas,	New Castle,
W. A. H. 36,	156	C. E. Thomas,	New Castle,
W. A. H. 34,	142	Thos. Augustine,	New Castle,
W. A. H. 32,	144	H. R. Huston,	New Castle,
W. A. H. 56,	145	J. Lee Cooper,	New Castle,
W. A. H. 30,	154	J. J. Miller,	New Castle,
W. A. H. 27,	155	I. P. Dean, Western Dairy Butter Co.	New Castle,
W. A. H. 74,	203	E. O'Brien & Son,	New Castle,

Oleomargarine Cases,

1333,	86	J. J. Williams,	Nanticoke,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Mercer County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
March 11, 1902,	March 22, 1902,	Selling colored "oleo,"	Civil.
March 11, 1902,	March 22, 1902,	Selling colored "oleo,"	Civil.
March 11, 1902,	March 22, 1902,	Selling colored "oleo,"	Civil.
May 29, 1902,		Selling colored "oleo;" no stamp; no license,.	Criminal.

Lawrence County.

March 11, 1902,	March 21, 1902,	Selling colored "oleo,"	Criminal.
March 11, 1902,	March 21, 1902,	Selling colored "oleo,"	Civil.
March 11, 1902,	March 21, 1902,	Selling colored "oleo,"	Criminal.
March 11, 1902,	March 21, 1902,	Selling colored "oleo,"	Criminal.
March 11, 1902,	March 21, 1902,	Selling colored "oleo,"	Criminal.
March 11, 1902,	March 21, 1902,	Selling colored "oleo,"	Civil.
March 11, 1902,	March 12, 1902,	Selling colored "oleo,"	Criminal.
March 11, 1902,	March 21, 1902,	Selling colored "oleo,"	Criminal.
April 24, 1902,	May 6, 1902,	Selling colored "oleo,"	Civil.

Luzerne County.

Jan. 20, 1902,	Feb. 8, 1902,	Selling "oleo" through orders,	Civil.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
W. A. H. 57,	147	J. J. Nolan,	Thomas Thomas,	Sharon,
W. A. H. 47,	149	M. Hirst,	Thomas Thomas,	Sharon.
W. A. H. 46,	150	Henri Hoelzel,	Thomas Thomas,	Sharon,
224,	16	John J. Heinbacker,	Thomas Thomas,	Sharon,

Oleomargarine Cases,

W. A. H. 26,	141	W. J. Hartzel,	W. W. Cubbison,	New Castle,
W. A. H. 28,	146	C. E. Thomas,	W. W. Cubbison,	New Castle,
W. A. H. 36,	156	C. E. Thomas,	W. W. Cubbison,	New Castle,
W. A. H. 34,	142	Thos. Augustine,	W. W. Cubbison,	New Castle,
W. A. H. 32,	144	H. R. Huston,	W. W. Cubbison,	New Castle,
W. A. H. 56,	145	J. Lee Cooper,	W. W. Cubbison,	New Castle,
W. A. H. 30,	154	J. J. Miller,	W. W. Cubbison,	New Castle,
W. A. H. 27,	155	Western Dairy Butt Co., I. P. Dean.	W. W. Cubbison,	New Castle,
W. A. H. 74,	203	E. O'Brien & Son,	W. W. Cubbison,	New Castle,

Oleomargarine Cases,

1333,	86	J. J. Williams,	Frank Brown,	Wilkes-Barre,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Mercer County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Continued to April 1, 1902; judgment in favor of Commonwealth, appealed to court.		
Continued to April 1, 1902; judgment in favor of Commonwealth, appealed to court.		
Waived hearing, bound over to court.		

Lawrence County—Continued.

Gave decision in favor of Commonwealth and deft. paid fine of $100 and costs.	....	Paid.
Deft. fined $100 and costs, ...	....	Paid.
This suit was dismissed in consideration of deft. paying fine and costs on W. A. H. 28; costs in this case paid.		
Deft. gave bail for court.		
Deft. gave bail for court.		
Judgment for $100 and costs; appealed.		
Deft. gave bail for court.		
Deft. gave bail for court.		
Judgment for $100 and costs; appealed to court.		

Luzerne County—Continued.

Case closed for lack of evidence, but deft. gave bond of $300 not to sell "oleo" again and paid all costs.		

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
H. L. B. 258,	237	Davis Bros.,	Wilkes-Barre,
H. L. B. 257,	238	J. J .Jones,	Wilkes-Barre,
H. L. B. 259,	239	J. F. Gilles,	Wilkes-Barre,
H. L. B. 260,	240	Russel Uhl,	Wilkes-Barre,
H. L. B., ...	243	Russel Uhl,	Wilkes-Barre,

Oleomargarine Cases,

143,	87	Carl Dannhauser,	S. W. Cor. 6th and Callowhill Sts., Phila.
J. M. S. 373, L. 439.	90	A. P. Cline,	S. W. Cor. 36th and Spruce Sts., Phila.
J. M. S. 382, L. 448.	91	John A. Frost,	1418 Cayugo St., Phila.,
J. M. S. 436, L. 505.	198	Lincoln Taylor,	58th and Market Sts., Phila.,
J. M. S. 437, L. 506.	199	Harry Dumas,	56th and Arch Sts., Phila.,
L. 507,	200	Lincoln Taylor,	58th and Market Sts., Phila.,
J. M. S. 391, L. 457.	205	A. P. Cline,	36th and Spruce Sts., Phila.,
J. M. S. 406, L. 474.	206	A. L. Van Wert,	2239 Frankford Av., Phila.,
J. M. S. 447, L. 516.	214	Quaker City Grocery, Chas. Chault,	5617 Market St., Phila.,
J. M. S. 479, L. 549.	233	A. L. Powdermaker,	933 Atlantic Av., Atlantic City,
L. 573,	234	David Ogden,	2417 Ridge Av., Phila.,

Oleomargarine Cases,

H. L. B. 115,	100	Thomas O'Conners,	Washington,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Luzerne County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
June 9, 1902,	June 20, 1902,	Selling colored "oleo,"	Civil.
June 9, 1902,	June 20, 1902,	Selling colored "oleo,"	Civil.
June 9, 1902,	June 20, 1902,	Selling colored "oleo,"	Civil.
June 9, 1902,	June 24, 1902,	Selling colored "oleo;" no license, ...	Civil.
June 22, 1902,	June 27, 1902,	Selling colored "oleo;" no license, ...	Civil.

Philadelphia County.

Feb. 10, 1902,	Feb. 17, 1902,	Selling colored "oleo,"	Civil.
Feb. 10, 1902,	Feb. 17, 1902,	Selling colored "oleo" without license, ...	Civil.
March 3, 1902,	March 3, 1902,	Selling colored "oleo;" no license, ...	Criminal.
April 21, 1902,	April 29, 1902,	Selling colored "oleo;" no license, ...	Criminal.
April 21, 1902,	April 29, 1902,	Selling colored "oleo;" no license, ...	Criminal.
April 21, 1902,	April 29, 1902,	Selling colored "oleo;" no license, ...	Criminal.
April 30, 1902,	May 6, 1902,	Selling colored "oleo;" no license, ...	Criminal.
	May 6, 1902,		
April 30, 1902,	May 20, 1902,	Selling colored "oleo;" no license, ...	Criminal.
May 16, 1902,	June 4, 1902,	Selling colored "oleo;" no license, ...	Criminal.
June 4, 1902,	June 17, 1902,	Selling colored "oleo;" no license, ...	Criminal.
June 17, 1902,	March 17, 1902,	Selling colored "oleo,"	Criminal.

Washington County.

March 8, 1902,	March 17, 1902,	Selling colored "oleo;" no license, ...	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.			Magistrate.	
Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
H. L. B. 258,	237	Davis Bros.,	Frank Brown,	Wilkes-Barre,
H. L. B. 257,	238	J. J. Jones,	Frank Brown,	Wilkes-Barre,
H. L. B. 259,	239	J. F. Gilles,	Frank Brown,	Wilkes-Barre,
H. L. B. 260,	240	Russel Uhl,	Frank Brown,	Wilkes-Barre,
H. L. B.,	243	Russel Uhl,	Frank Brown,	Wilkes-Barre,

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
143,	87	Carl Dannhauser,	Henry R. Stratton,	Philadelphia,
J. M. S. 373, L. 439.	90	A. P. Cline,	Henry R. Stratton,	Philadelphia,
J. M. S. 382, L. 448.	91	John A. Frost,	Henry R. Stratton,	Philadelphia,
J. M. S. 436, L. 505.	198	Lincoln Taylor,	Henry R. Stratton,	Philadelphia,
J. M. S. 437, L. 506.	199	Harry Dumas,	Henry R. Stratton,	Philadelphia,
L. 507,	200	Lincoln Taylor,	Henry R. Stratton,	Philadelphia,
J. M. S. 391, L. 457.	205	A. P. Cline,	Henry R. Stratton,	Philadelphia,
J. M. S. 406, L. 474.	206	A. L. Van Wert,	Henry R. Stratton,	Philadelphia.
J. M. S. 447, L. 516.	214	Quaker City Grocery, Chas. Chault.	Henry R. Stratton,	Philadelphia.
J. M. S. 479, L. 549.	233	A. L. Powdermaker,	Henry R. Stratton,	Philadelphia,
L. 573,	234	David Ogden,	Henry R. Stratton,	Philadelphia,

Oleomargarine Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
H. L. B. 115,	100	Thomas O'Conners,	D. M. Donehoo,	Washington,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Luzerne County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Judgment by default.		
Judgment for Commonwealth.		
Judgment given for Commonwealth.		
Judgment by default.		
Judgment given.		

Philadelphia County—Continued.

Defdt's. case was held under advisement to insure his appearance against J. Frost.		
Judgment given for $100 and costs; appealed to court.		
Defdt. held for court.		
Postponed for a week.		
Postponed for a week.		
Postponed for a week.		
Defdt. gave $400 bail for court.		
Magistrate held defdt. in $1,000 bail for court.		
Held deft. in $300 bail.		

Washington County—Continued.

Waived hearing, plead guilty; magistrate imposed fine of $100 and costs of $4.50.	....	Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
H. L. B. 240,	136	"Cozy Cafe," A. M. Vester,	132 S. Main St., Washington,
H. L. B.,	139	D. E. McWhorton & J. D. Boyle,	Restaurant, Washington,
W. 289,	167	Frank Shanks,	McDonald,
W. 320,	163	Frank Shanks,	McDonald,
W. 375,	169	Geo. S. Daugherty,	East Pike St., Canonsburg,
M. 186,	170	J. A. Bastian,	Lincoln St., McDonald,
M. 275,	172	W. G. Nease,	233 W. Chestnut St., Washington,
M. 193,	171	Fred. Barer,	Barr St., McDonald,
W. 370,	168	W. G. Nease,	116 S. Main St., Washington,
M. 293,	97	Chicago Dairy Co., L. O. Swank,	Fallowfield Av., Charleroi,
P. 773,	165	Charles H. Gordon,	142 W. Chestnut St., Washington,
P. 726,	166	W. G. Nease,	116 S. Main St., Washington,
M. 278,	176	J. Glass & W. Speer,	Pike St., Canonsburg,
W. 300,	212	Frank Shanks,	Steubenville,

Oleomargarine Cases,

W. A. H. 25,	71	C. M. Williams,	Latrobe,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Washington County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
March 8, 1902,	March 17, 1902,	Selling colored “oleo;” no license, ...	Criminal.
March 8, 1902,		Selling colored “oleo;” no license, ...	Criminal.
March 11, 1902,	March 26, 1902,	Selling colored “oleo;” no license, ...	Criminal.
March 11, 1902,	March 26, 1902,	Selling colored “oleo;” no license, ...	Criminal.
March 11, 1902,	March 26, 1902,	Selling colored “oleo,”	Criminal.
March 11, 1902,	March 26, 1902,	Selling colored “oleo;” no license; signs, ...	Criminal.
March 11, 1902,	March 26, 1902,	Selling colored “oleo;” no license; no stamps,..	Criminal.
March 11, 1902,	March 26, 1902,	Selling colored “oleo;” no license; no stamps,..	Criminal.
March 11, 1902,	March 26, 1902,	Selling colored “oleo;” no stamp, ...	Criminal.
March 11, 1902,	March 17, 1902,	Selling colored “oleo;” no stamp, ...	Criminal.
March 19, 1902,	March 26, 1902,	Selling colored “oleo;” no stamp, ...	Criminal.
March 19, 1902,	March 26, 1902,	Selling colored “oleo;” no license, ...	Criminal.
March 21, 1902,	March 26, 1902,	Selling colored “oleo;.. no license, ...	Criminal.
May 15, 1902,	May 15, 1902,	Selling colored “oleo;.. no license, ...	Criminal.

Westmoreland County.

Feb. 3, 1902,	Feb. 3, 1902,	Violation “oleo” laws, ...	Civil.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
H. L. B. 240,	136	"Cozy Cafe," A. M. Vester.	D. M. Donehoo,	Washington,
H. L. B.,	139	D. E. McWhorton & J. D. Boyle.	D. M. Donehoo,	Washington.
W. 289,	167	Frank Shanks,	D. M. Donehoo,	Washington,
W. 320,	163	Frank Shanks,	D. M. Donehoo,	Washington,
W. 375,	169	Geo. S. Daugherty,	D. M. Donehoo,	Washington,
M. 186,	170	J. A. Bastian,	D. M. Donehoo,	Washington,
M. 275,	172	W. G. Nease,	D. M. Donehoo,	Washington,
M. 193,	171	Fred. Barer,	D. M. Donehoo,	Washington,
W. 370,	168	W .G. Nease,	D. M. Donehoo,	Washington,
M. 293,	97	Chicago Dairy Co., L. O. Swank.	D. M. Donehoo,	Washington,
P. 773,	165	Charles H. Gordon,	D. M. Donehoo,	Washington,
P. 726,	166	W. G. Nease,	D. M. Donehoo,	Washington,
M. 278,	176	J. Glass & W. Speer,	D. M. Donehoo,	Washington,
W. 300,	212	Frank Shanks,	D. M. Donehoo,	Washington,

Oleomargarine Cases,

W. A. H. 25,	71	C. M. Williams,	J. P. Eicher,	Greensburg,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Washington County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Judgment for $100 and costs.		
Defdt. plead guilty and magistrate imposed fine of $100 and costs.		Paid.
Magistrate dismissed case upon payment of costs as defdt. plead guilty.		Paid costs.
Criminal suit withdrawn and civil suit entered; defdt. plead guilty and paid fine of $100 and costs.		Paid.
Criminal suit withdrawn and civil suit entered; defdt. plead guilty and paid fine of $100 and costs.		Paid.
Entered bail for court in sum of $200.		
Entered bail for court in sum of $200.		
Entered bail for court in sum of $200.		
Defdt. waived hearing and entered bail for court.		
Gave bail for court in $300.		
Waived hearing and gave bail for court.		
Criminal suit withdrawn, civil proceedings entered, defdt. plead guilty, fine of $100 and costs.		Paid.
Defdt. plead guilty and magistrate dismissed case upon payment of costs.		Paid.

Westmoreland County—Continued.

Defdt. plead guilty and paid fine of $100 and costs.		Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
W. A. H. 10,	72	G. W. Miller & F. C. Patterson, ..	Penn Station, ...
W. A. H. 24,	73	Dominicko Cerare, ...	Millwood Shaft, ...
W. A. H. 22,	75	John Porter, ...	Irwin, ...
W. A. H. 11,	76	James Hutchison, ...	Greensburg, ...
McG. 74, ...	160	R. H. Crawford, ...	Latrobe, ...
McG. 73, ...	161	Chicago Dairy Co., Wm. Sprague,	Greensburg, ...
McG. 72, ...	177	Thomas Mulholland, ...	Jeannette, ...
McG. 75, ...	178	William Pasco, ...	New Kensington, ...

Oleomargarine Cases,

68, ...	204	J. W. & F. E. Grove, ...	Franklin, ...
70, ...	164	C. J. Wright, ...	Franklin, ...

Oleomargarine Case

L. 452, ...	64	George Campbell, ...	York, ...

Oleomargarine Cases—Suits Prosecuted by Luther S. Kauffman, Attor

1241, ...	5	John A. Graham, ...	No. 1104 Passyunk Av., Phila., ...
1243, ...	6	Asa L. Van Wert, ...	No. 419 E. Girard Av., Phila., ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Westmoreland County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Feb. 6, 1902,	Feb. 15, 1902,	Violation "oleo" laws,	Criminal.
Feb. 6, 1902,	Feb. 15, 1902,	Violation "oleo" laws,	Criminal.
Feb. 6, 1902,	Feb. 15, 1902,	Violation "oleo" laws,	Criminal.
Feb. 6, 1902,	Feb. 15, 1902,	Violation "oleo" laws,	Criminal.
March 10, 1902,	March 14, 1902,	Selling colored "oleo,"	Civil.
March 10, 1902,	March 14, 1902,	Selling colored "oleo,"	Civil.
March 24, 1902,	March 25, 1902,	Violation of "oleo" laws,	Civil.
March 24, 1902,	....	Violation of "oleo" laws,	Civil.

Venango County.

Feb. 28, 1902,	March 7, 1902,	Violation "oleo" law,	Civil.
March 13, 1902,	March 21, 1902,	Selling colored "oleo,"	Civil.

York County.

Jan. 14, 1902,	Jan. 14, 1902,	Serving colored "oleo" on hotel table,	Civil.

ney for the Pure Butter Protective Association of Philadelphia, Pa.

April 2, 1902,	....	Selling colored "oleo,"	Criminal.
April 2, 1902,	....	Selling colored "oleo,"	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
W. A. H. 10,	72	G. W. Miller & F. C. Patterson.	J. P. Eicher,	Greensburg,
W. A. H. 24,	73	Dominicko Cerare,	J. P. Eicher,	Greensburg,
W. A. H. 22,	75	John Porter,	J. P. Eicher,	Greensburg,
W. A. H. 11,	76	James Hutchison,	J. P. Eicher,	Greensburg,
McG. 74,	160	R. H. Crawford,	J. P. Eicher,	Greensburg,
McG. 73,	161	Chicago Dairy Co., William Sprague.	J. P. Eicher,	Greensburg,
McG. 72,	177	Thomas Mulholland,	J. P. Eicher,	Greensburg,
McG. 75,	178	William Pasco,	J. P. Eicher,	Greensburg,

Oleomargarine Case,

68,	204	J. W. & F. E. Grove,	M. R. Henderson,	Franklin,
70,	164	C. J. Wright,	M. R. Henderson,	Franklin,

Oleomargarine Case,

L. 452,	64	George Campbell,	Jacob Stager,	York,

Oleomargarine Cases—Suits Prosecuted

1241,	5	John A. Graham,	J. M. R. Jermon,	Philadelphia,
1243,	6	Asa L. Van Wert,	J. M. R. Jermon,	Philadelphia,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Westmoreland County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Held for court, ...	Bail was forfeited on account of non-appearance of defdt. and bench warrant ordered by court for this arrest.	
Held for court, ...	Defdt. plead guilty; paid fine of $100 and costs.	Paid.
Held for court, ...	Case withdrawn upon payment of costs.	
Held for court, ...	Defdt. found guilty; fined $100 and costs.	Paid.
Defdt. appeared, confessed judgment for $100 and costs.	....	Paid.
Defdt. appeared, confessed judgment for $100 and costs.	....	Paid.
Defdt. confessed judgment for $100 and costs.	....	Paid.
Defdt. confessed judgment for $100 and costs.	....	Paid.

Venango County—Continued.

Defdt. confessed judgment for $100 and costs.	....	Paid.
Fined defdt. $100 and costs, ...	Appealed.	

York County Continued.

Defdt paid fine of $100 without a hearing,	....	Paid.

by Luther S. Kauffman—Continued.

Dedft. held in $350 bail for court,..	Grand jury found true bill May 13, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill May 13, 1902.	

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases—Suits Prosecuted

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
1240, ...	4	John A. Graham, ...	No. 1104 Passyunk Av., Phila., ...
1211, ...	8	John A. Graham, ...	No. 1104 Passyunk Av., Phila., ...
1215, ...	9	Patrick McEnroe, ...	No. 1910 McClelland St., Phila., ..
1214, ...	10	James Gildea, ...	No. 2108 Pierce St., Phila., ...
1216, ...	11	Anthony Meehan, ...	Dickinson and Bambrey Sts., Phila ,
1242, ...	13	John B. Wharton, ...	2239 Frankford Av., Phila., ...
1217, ...	14	John Fair, ...	3d and Winton Sts., Phila., ...
1244, ...	15	Asa L. Van Wert, ...	No. 419 E. Girard Av., Phila., ...
1212, ...	16	John A. Graham, ...	1104 Passyunk Av., Phila., ...
1221, ...	17	Edward Barr, ...	128 Dualey St., Phila., ...
1222, ...	18	Patrick McEnroe, ...	1910 McClelland St., Phila., ...
1228, ...	19	John A. Graham, ...	1104 Passyunk Av., Phila., ...
1245, ...	20	Asa L. Van Wert, ...	419 E. Girard Av., Phila., ...
1247, ...	21	Asa L. Van Wert, ...	419 E. Girard Av., Phila., ...
1249, ...	22	John A. Graham, ...	1104 Passyunk Av., Phila., ...
1208, ...	23	John Wharton, ...	419 E. Girard Av., Phila., ...
1215, ...	24	James Gildea, ...	No. 2108 Pierce St., Phila., ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

by Luther S. Kauffman—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
April 7, 1902,	....	Selling colored "oleo,"	Criminal.
April 25, 1902,	April 25, 1902,	Selling colored "oleo,"	Criminal.
April 25, 1902,	....	Selling colored "oleo,"	Criminal.
April 25, 1902,	April 25, 1902,	Selling colored "oleo,"	Criminal.
April 25, 1902,	....	Selling colored "oleo,"	Criminal.
April 25, 1902,	....	Selling colored "oleo,"	Criminal.
May 2, 1902,	May 2, 1902,	Selling colored "oleo,"	Criminal.
May 2, 1902.	....	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases—Suits Prosecuted

Sample.			Magistrate.	
Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
1240, ...	4	John A. Graham, ...	J. M. R. Jermon, ...	Philadelphia, ...
1211, ...	8	John A. Graham, ...	J. M. R. Jermon, ...	Philadelphia, ...
1215, ...	9	Patrick McEnroe, ...	J. M. R. Jermon, ...	Philadelphia, ...
1214, ...	10	James Gildea, ...	J. M. R. Jermon, ...	Philadelphia, ...
1216, ...	11	Anthony Meehan, ...	J. M. R. Jermon, ...	Philadelphia, ...
1242, ...	13	John B. Wharton, ...	J. M. R. Jermon, ...	Philadelphia, ...
1217, ...	14	John Fair, ...	J. M. R. Jermon, ...	Philadelphia, ...
1244, ...	15	Asa L. Van Wert, ...	J. M. R. Jermon, ...	Philadelphia, ...
1212, ...	16	John A. Graham, ...	J. M. R. Jermon, ...	Philadelphia, ...
1221, ...	17	Edward Barr, ...	J. M. R. Jermon, ...	Philadelphia, ...
1222, ...	18	Patrick McEnroe, ...	J. M. R. Jermon, ...	Philadelphia, ...
1228, ...	19	John A. Graham, ...	J. M. R. Jermon, ...	Philadelphia, ...
1245, ...	20	Asa L. Van Wert, ...	J. M. R. Jermon, ...	Philadelphia, ...
1247, ...	21	Asa L. Van Wert, ...	J. M. R. Jermon, ...	Philadelphia, ...
1249, ...	22	John A. Graham, ...	J. M. R. Jermon, ...	Philadelphia, ...
1208, ...	23	John Wharton, ...	J. M. R. Jermon, ...	Philadelphia, ...
1215, ...	24	James Gildea, ...	J. M. R. Jermon, ...	Philadelphia, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

by Luther S. Kauffman—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Hearing waived; held for court in $350 bail.	Grand jury found true bill May 13, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill May 13, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill May 13, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill May 13, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill May 13, 1902.	
Held in $500 bail for court, ...	Grand jury found true bill May 13, 1902.	Jury rendered verdict of not guilty, as chemist was not present; date of trial in court June 10, 1902.
Hearing waived; held in $500 bail for court.	Grand jury found true bill May 13, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill May 13, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Hearing waived; held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Case continued to May 26, 1902; June 10, 1902, defdt. waived-hearing and was held for court in $600 bail.		
Continued.		

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases—Suits Prosecuted

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
1220, ...	25	John B. Wharton, ...	No. 419 E. Girard Av., Phila., ...
1225, ...	26	John B. Wharton, ...	No. 419 E. Girard Av., Phila., ...
1246, ...	27	John B. Wharton, ...	2239 Frankford Av., Phila., ...
1248, ...	28	John B. Wharton, ...	2239 Frankford Av., Phila., ...
1223, ...	29	John Fair, ...	3d and Winton Sts., Phila., ...
1250, ...	30	Chas. A. Choate, ...	No. 6212 Girard Av., Phila., ...
1251, ...	31	W. W. Doughty, ...	1425 N. 10th St., Phila., ...
1252, ...	32	John McGuckin, ...	1649 S. 17th St., ...
1253, ...	33	John McGuckin, ...	1649 S. 17th St., ...
1260, ...	35	William Ogden, ...	2417 Ridge Av., Phila., ...
1257, ...	34	William Ogden, ...	2417 Ridge Av., Phila., ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

by Luther S. Kauffman—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
May 24, 1902,	May 24, 1902,	Selling colored "oleo,"	Criminal.
June 14, 1902,	June 26, 1902,	Selling colored "oleo,"	Criminal.
June 16, 1902,	June 23, 1902,	Selling colored "oleo,"	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Cases—Suits Prosecuted

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
1220,	25	John B. Wharton,	J. M. R. Jermon,	Philadelphia,
1225,	26	John B. Wharton,	J. M. R. Jermon,	Philadelphia,
1246,	27	John B. Wharton,	J. M. R. Jermon,	Philadelphia,
1248,	28	John B. Wharton,	J. M. R. Jermon,	Philadelphia,
1223,	29	John Fair,	J. M. R. Jermon,	Philadelphia,
1250,	30	Chas. A. Choate,	J. M. R. Jermon,	Philadelphia,
1251,	31	W. W. Doughty,	J. M. R. Jermon,	Philadelphia,
1252,	32	John McGuckin,	J. M. R. Jermon,	Philadelphia,
1253,	33	John McGuckin,	J. M. R. Jermon,	Philadelphia,
1260,	35	William Ogden,	J. M. R. Jermon,	Philadelphia,
1257,	34	William Ogden,	J. M. R. Jermon,	Philadelphia,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

by Luther S. Kauffman—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Case continued to May 26, 1902; June 10, 1902, defdt. waived-hearing and was held for court in $600 bail.		
Case continued to May 26, 1902; June 10, 1902, defdt. waived-hearing and was held for court in $600 bail.		
Case continued to May 26, 1902; June 10, 1902, defdt. waived-hearing and was held for court in $600 bail.		
Case continued to May 26, 1902; June 10, 1902, defdt. waived-hearing and was held for court in $600 bail.		
Case continued to May 26; hearing waived, held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Continued.		
Case continued to May 26, 1902 and May 27, 1902; hearing waived; held for court in $500 bail.	Grand jury found true bill June 9, 1902.	
Case continued to May 26, 1902; hearing waived, held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Case continued to May 26, 1902; hearing waived, held in $500 bail for court.	Grand jury found true bill June 9, 1902.	
Continued to June 30; June 27 defdt. waived hearing and gave bail for court.		
June 27, 1902, defendant waived hearing and entered bail for court.		

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Case—Suit Prosecuted by

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
1,	7	L O. Swank,	536 Fallowfield Av., Charleroi,

Pure Food Cases,

Agent's number and mark.	Docket number.	Name.	Address.
P. 724,	2012	E. Ziegler,	3710 Butler St., Pittsburg,
230 H. L. B.,	2035	H. C. Schwartz,	97-99-101 Grant Av., Millvale,
211 H. L. B.,	2025	S. T. Philips,	Waynesburg,
767 P.,	2121	Annie Burns,	310 Ross St., Pittsburg,
722 P.,	2120	Herman H. Studt,	15 Magee St., Pittsburg,
298 M.,	2132	J. G. Dollman,	Stand 2, Market House, Allegheny,.
296 M.,	2131	H. McDermott,	223 Fifth Av., McKeesport,
277 W.,	2134	Mrs. N. Schweitzer,	Cor. Lacock and Madison Sts., Allegheny.

Pure Food Cases,

Agent's number and mark.	Docket number.	Name.	Address.
40 W. A. H.,	2034	J. I. Aye,	Beaver Falls,
67 W. A. H.,	2077	A. G. Harvey,	New Brighton,
60 W. A. H.,	2078	R. J. Jamison,	Beaver Falls,
41 W. A. H.,	2033	Mrs. J. B. Parris,	Beaver Falls,

Pure Food Cases,

Agent's number and mark.	Docket number.	Name.	Address.
465 F.,	2047	H. Miller,	Tyrone,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Frank Patterson, of Charleroi, Pa.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
March 12, 1902,	March 13, 1902,	Selling colored "oleo,"	Criminal.

Allegheny County.

Jan. 30, 1902,	Feb. 8, 1902,	Selling adulterated vanilla extract, ...	Criminal.
March 10, 1902,	March 20, 1902,	Selling vanilla extract, colored and flavored, ..	Criminal.
March 11, 1902,	March 18, 1902,	Selling lemon extract, ...	Criminal.
May 29, 1902,	June 5, 1902,	Selling adulterated apple butter, ...	Criminal.
May 29, 1902,	June 5, 1902,	Selling adulterated vanilla extract, ...	Criminal.
June 30, 1902,	July 7, 1902,	Selling preserved meat, ...	Criminal.
June 30, 1902,	July 7, 1902,	Selling preserved meat, ...	Criminal.
June 30, 1902,	July 7, 1902,	Selling adulterated lemon extract, ...	Criminal.

Beaver County.

March 12, 1902,	March 21, 1902,	Vanilla extract, ...	Criminal.
April 25, 1902,	May 5, 1902,	Violation of pure food law, ...	Criminal.
April 25, 1902,	May 5, 1902,	Violation of pure food law, ...	Criminal.
March 12, 1902,	March 21, 1902,	Selling adulterated frankfurta sausage, ...	Criminal.

Blair County.

March 26, 1902,	....	Selling preserved and chopped meat, ...	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Oleomargarine Case—Suit Prosecuted

Sample.			Magistrate.	
Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
1,	7	L. O. Swank,	E. H. Prowitt,	Washington,

Pure Food Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
P. 724,	2012	E. Ziegler,	James V. McMasters,	Pittsburg,
230 H. L. B.,	2035	H. C. Schwartz,	John Groetzinger,	Pittsburg,
211 H. L. B.,	2025	S. T. Philips,	John Groetzinger,	Pittsburg,
767 P.,	2121	Annie Burns,	J. V. McMasters,	Pittsburg,
722 P.,	2120	Herman S. Studt,	J. V. McMasters,	Pittsburg,
298 M.,	2132	J. G. Dollman,	John Groetzinger,	Pittsburg,
296 M.,	2131	H. McDermott,	John Groetzinger,	Pittsburg,
277 W.,	2134	Mrs. N. Schweitzer,	John Groetzinger,	Pittsburg,

Pure Food Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
40 W. A. H.,	2034	J. I. Aye,	Stephen Minor,	Beaver,
67 W. A. H.,	2077	A. G. Harvey,	Stephen Minor,	Beaver,
60 W. A. H.,	2078	R. J. Jamison,	Stephen Minor,	Beaver,
41 W. A. H.,	2033	Mrs. J. B. Parris,	Stephen Minor,	Beaver,

Pure Food Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
465 F.,	2047	H. Miller,	David P. Hart,	Altoona,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

by Frank Patterson—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Defdt. bound to court.		

Allegheny County—Continued.

Held for court.		
Defdt. held for court in $300.		
Waived hearing, entered plea of guilty and magistrate imposed fine of $50 for costs.		Paid.
Magistrate held defdt for court.		
Magistrate held deft. for court; judgment for $50 and $4.50 for costs.		Paid.
Held for court in sum of $300; defdt. plead guilty and magistrate accepted fine of $50 and $4.50 costs.		Paid.
Paid same to J. K. Cope; judgment for $50 and $4.50 costs.		Paid.
Reserved decision for few days.		

Beaver County—Continued.

Defdt. gave bail for court.		
Case dismissed as chemist mislayed sample and could not produce it.		
Defdt. entered bail for court.		
Defdt. entered bail for court, ...	June 5, 1902; defdt. plead guilty and paid a fine of $50 and $7.12 costs.	Paid.

Blair County—Continued.

Waived hearing and entered bail for court	$50 to district attorney.	Paid,

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
467 F., ...	2048	Wm. Hicks & Fred. Hicks, ...	Tyrone, ...
468 F., ...	2049	Wm. & Fred. Hicks, ...	Tyrone, ...
469 F., ...	2050	R. S. Minnich, ...	Tyrone, ...

Pure Food Cases,

S. M. R. 1206,	2016	O. J. Saeger, ...	Leighton, ...
S. M. R. 1207,	2017	O. J. Saeger, ...	Leighton, ...
S. M. R. 1205,	2015	O. J. Saeger, ...	Leighton, ...
S. M. R. 1208,	2070	A. A. Beltz, ...	Weissport, ...

Pure Food Cases,

453 F., ...	1996	George Richards, ...	Philipsburg, ...
447 F., ...	1997	A. L. Peters, ...	Philipsburg, ...
450 F., ...	1998	M. I. Forcey, ...	Philipsburg, ...
448 F., ...	1995	L. G. Kessler, ...	Philipsburg, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Blair County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
March 26, 1902,	....	Selling adulterated Weiner sausage, ...	Criminal.
March 26, 1902,	....	Selling adulterated bologna sausage, ...	Criminal.
March 26, 1902,	....	Selling Weiner sausage, colored and preserved,	Criminal.

Carbon County.

March 7, 1902,	March 13, 1902,	Selling renovated butter, ...	Criminal.
March 7, 1902,	March 13, 1902,	Selling renovated butter, ...	Criminal.
March 13, 1902,	March 13, 1902,	Selling renovated butter, ...	Criminal.
April 15, 1902,	April 15, 1902,	Selling adulterated pepper, ...	Criminal.

Centre County.

Feb. 5, 1902,	Feb. 22, 1902,	Selling adulterated bologna sausage, ...	Criminal.
Feb. 5, 1902,	Feb. 22, 1902,	Selling adulterated Weiner sausage, ...	Criminal.
Feb. 5, 1902,	Feb. 22, 1902,	Selling adulterated bologna sausage, ...	Criminal.
Feb. 5, 1902,	Feb. 22, 1902,	Selling preserved oysters, formaldehyde, ...	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
467 F., ...	2048	Wm. Hicks & Fred. Hicks.	David P. Hart, ...	Altoona, ...
468 F., ...	2049	Wm. & Fred. Hicks, ...	David P. Hart, ...	Altoona, ...
469 F., ...	2050	R. S. Minnich, ...	David P. Hart, ...	Altoona, ...

Pure Food Cases,

S. M. R. 1206,	2016	O. J. Saeger, ...	Wm. A. Beltz, ...	Leighton, ...
S. M. R. 1207,	2017	O. J. Saeger, ...	Wm. A. Beltz, ...	Leighton, ...
S. M. R. 1205,	2015	O. J. Saeger, ...	Wm. A. Beltz, ...	Leighton, ...
S. M. R. 1208,	2070	A. A. Beltz, ...	Wm. A. Beltz, ...	Leighton, ...

Pure Food Cases,

453 F., ...	1996	George Richards, ...	B. J. LaPorte, ...	Philipsburg, ...
447 F., ...	1997	A. L. Peters, ...	B. J. LaPorte, ...	Philipsburg, ...
450 F., ...	1993	M. I. Forcey, ...	B. J. LaPorte, ...	Philipsburg, ...
448 F., ...	1995	L. G. Kessler, ...	B. J. LaPorte, ...	Philipsburg, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Blair County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Waived hearing and entered bail for court.	Defdt. appeared before district attorney; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Defdt. appeared before district attorney; plead guilty; case dismissed on payment of costs.	
Waived hearing and entered bail for court.	Defdt. appeared before district attorney; plead guilty; fine of $50.	Paid.
Carbon County—Continued.		
Case continued on account of defdt.'s absence; defdt. plead guilty; $100 costs.		Paid.
Case continued on account of absence; non pros. entered upon payment of costs.		
Case continued on account of absence; non pros. entered upon payment of costs.		
Defdt. plead guilty; analy. fee and costs.		Paid.
Centre County—Continued.		
Waived hearing; defdt. appeared before district attorney; plead guilty; fine of $50.		Paid.
Waived hearing; defdt. appeared before district attorney; plead guilty; fine of $50.		Paid.
Waived hearing; defdt. appeared before district attorney; plead guilty; fine of $50.		Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
226 F., ...	1999	F. S. Lewis, ...	Johnstown, ...
244 F., ...	2000	Joseph & J. D. Cawthem, ...	Johnstown, ...

Pure Food Cases,

301 F., ...	1983	E. K. Kilburn, ...	DuBois, ...
356 F., ...	1984	John L. Mayer, ...	Smoke Run, ...
458 F., ...	1994	A. S. Brown, ...	Osceola, ...
489 F., ...	2041	S. E. Lenkard, ...	DuBois, ...
480 F., ...	2054	J. & W. Humphrey, ...	Clearfield, ...
486 F., ...	2038	Hugh A. Easter, ...	DuBois, ...
481 F., ...	2039	J. I. Heller, ...	Clearfield, ...
491 F., ...	2040	Chas. Weir, ...	DuBois, ...
487 F., ...	2042	Riling & Winner, ...	DuBois, ...
484 F., ...	2043	Chas. Sheffler, ...	DuBois, ...
475 F., ...	2044	B. W. Spencer, ...	Curwensville, ...
460 F., ...	2045	G. I. Waddell, ...	Coalport, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Cambria County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Feb. 10, 1902,	Feb. 25, 1902,	Selling adulterated cocoa,	Criminal.
Feb. 10, 1902,	Feb. 25, 1902,	Selling adulterated cocoa,	Criminal.

Clearfield County.

Jan. 2, 1902,	Jan. 25, 1902,	Selling adulterated French peas,	Criminal.
Jan. 2, 1902,	Jan. 25, 1902,	Selling vanilla extract,	Criminal.
Feb. 5, 1902,	Feb. 22, 1902,	Selling bologna sausage,	Criminal.
March 25, 1902,	....	Selling egg noodles,	Criminal.
March 25, 1902,	....	Selling Weiner sausage, preserved,	Criminal.
March 25, 1902,	....	Selling bologna sausage, preserved,	Criminal.
March 25, 1902,	....	Selling Weiner sausage, preserved,	Criminal.
March 25, 1902,	....	Selling bologna sausage preserved,	Criminal.
March 25, 1902,	....	Selling Weiner sausage preserved,	Criminal.
March 25, 1902,	....	Selling Weiner sausage preserved,	Criminal.
March 25, 1902,	....	Selling adulterated pine apple extract,	Criminal.
March 25, 1902,	....	Selling adulterated lemon extract,	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
226 F.,	1999	F. S. Lewis,	John A. Jones,	Johnstown,
244 F.,	2000	Joseph & J. D. Cawthem.	John A. Jones,	Johnstown,

Pure Food Cases,

Agent's number and mark.	Docket number.	Name—Defendant.	Magistrate—Name.	Magistrate—Address.
301 F.,	1983	E. K. Kilburn,	P. Gallagher,	Osceola,
356 F.,	1984	John L. Mayer,	P. Gallagher,	Osceola,
458 F.,	1994	A. S. Brown,	P. Gallagher,	Osceola,
489 F.,	2041	S. E. Lenkard,	P. Gallagher,	Osceola,
480 F.,	2054	J. & W. Humphrey,	P. Gallagher,	Osceola,
486 F.,	2038	Hugh A. Easter,	P. Gallagher,	Osceola,
481 F.,	2039	J. I. Heller,	P. Gallagher,	Osceola,
491 F.,	2040	Chas. Weir,	P. Gallagher,	Osceola,
487 F.,	2042	Riling & Winner,	P. Gallagher,	Osceola,
484 F.,	2043	Chas. Sheffler,	P. Gallagher,	Osceola,
475 F.,	2044	B. W. Spencer,	P. Gallagher,	Osceola,
460 F.,	2045	G. I. Waddell,	P. Gallagher,	Osceola,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Cambria County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Defdt. appeared and paid fine of $50 and costs.	....	Paid.
Defdt. appeared and paid fine of $50 and costs.	....	Paid.

Clearfield County—Continued.

By Magistrate.	By the Court.	Final.
Defdt. plead guilty; fine of $50, ..	....	Paid.
Defdt. plead guilty; fine of $50, ..	....	Paid.
Hearing waived; defdt. appeared before magistrate; plead guilty; fine of $50.	....	Paid.
Waived hearing and entered bail for court.		
Waived hearing and entered bail for court.		
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
477 F.,	2051	Theo. Deitrich,	Curwensville,
478 F.,	2052	A .J. McMaul,	Curwensville,
479 F.,	2053	Peter Kreher,	Clearfield,
485 F.,	2055	H. Hoffman & P. Dunn,	DuBois,

Pure Food Cases,

37,	2002	W. H. Nelson,	Chester,
77,	2003	W. S. Mingin,	Chester,
83,	2037	Solomon N. Freidkon,	Chester,

Pure Food Case,

H. L. B. 210,	2024	I. H. Johnson,	Waynesburg,

Pure Food Case,

28,	2013	J. P. Gates,	Lebanon,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Clearfield County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
March 25, 1902,	....	Selling bologna sausage preserved, ...	Criminal.
March 25, 1902,	....	Selling bologna sausage preserved, ...	Criminal.
March 25, 1902,	....	Selling bologna sausage preserved, ...	Criminal.
March 25, 1902,	....	Selling bologna sausage preserved, ...	Criminal.

Delaware County.

Feb. 3, 1902,	Feb. 7, 1902,	Adulterated chocolate, ...	Criminal.
Feb. 3, 1902,	Feb. 7, 1902,	Adulterated cocoa, ...	Criminal.
March 15, 1902,	March 22, 1902,	Adulterated artificial sweet cider, ...	Criminal.

Greene County.

March 11, 1902,	March 18, 1902,	Selling vanilla extract, ...	Criminal.

Lebanon County.

Feb. 24, 1902,	Feb. 26, 1902,	Foreign fat in cocoa bean, ...	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
477 F.,	2051	Theo. Deitrich,	P. Gallagher,	Osceola,
478 F.,	2052	A. I. McMaul,	P. Gallagher,	Osceola,
479 F.,	2053	Peter Kreher,	P. Gallagher,	Osceola,
485 F.,	2055	H. Hoffman & P. D. Dunn.	P. Gallagher,	Osceola,

Pure Food Cases,

37,	2002	W. H. Nelson,	Robt. Smith,	Chester,
77,	2003	W. S. Mingin,	Robt. Smith,	Chester,
83,	2037	Solomon Freidkon,	Robt. Smith,	Chester,

Pure Food Case,

H. L. B. 210,	2024	I. H. Johnson,	G. W. Ullon,	Waynesburg,

Pure Food Case,

28,	2013	J. P. Gates,	D. Smith,	Lebanon,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Clearfield County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Waived hearing and entered bail for court.	As deft. has gone out of business, remitted upon payment of costs.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.
Waived hearing and entered bail for court.	Deft. appeared before magistrate; plead guilty; fine of $50.	Paid.

Delaware County—Continued.

Hearing continued; defdt. held for court; case continued.		
Case continued; defdt. held for court on bail.		
Held for court.		

Greene County—Continued.

Hearing waived; magistrate imposed fine of $50 and costs of $11.55.	....	Paid.

Lebanon County—Continued.

Defdt. returned all goods to manufacturer; case was settled on payment of costs and $5 chemist's fee.	....	Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
137,	2009	Wm. Deisroth,	Hazleton,
136,	2010	Wm. Deisroth,	Hazleton,

Pure Food Case,

W. A. H. 35,	2032	W. R. McKee,	New Castle,

Pure Food Cases,

64,	2004	W. B. Hedrick,	Hatfield,
62,	2005	M. K. Hunsberger,	Soudertown,
63,	2021	H. M. Nice,	Soudertown,

Pure Food Case,

S. M. R. 1229,	2072	J. H. Shotwell & Roe Shotwell,	Stroudsburg,

Pure Food Cases,

S. M. R. 1218,	2019	Schneider Bros.,	Mt. Carmel,
S. M. R. 1220,	2020	Schneider Bros.,	Mt. Carmel,
S. M. R. 1193,	2057	Morris Bastian & Wilson Arbugast.	Allentown,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Luzerne County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Jan. 10, 1902,	Jan. 18, 1902,	Selling adulterated strawberry extract, ...	Criminal.
Jan. 10, 1902,	Jan. 18, 1902,	Selling adulterated honey, ...	Criminal.

Lawrence County.

March 11, 1902,	March 21, 1902,	Selling adulterated banana extract, ...	Criminal.

Montgomery County.

Feb. 4, 1902,	Feb. 15, 1902,	Selling adulterated cocoa, ...	Criminal.
Feb. 4, 1902,	Feb. 15, 1902,	Cotton seed oil sold as olive oil, ...	Criminal.
March 7, 1902,	....	Selling adulterated chocolate, ...	Criminal.

Monroe County.

April 22, 1902,	April 23, 1902,	Selling adulterated mustard, ...	Criminal.

Northampton County.

March 4, 1902,	March 4, 1902,	Selling adulterated honey, ...	Criminal.
March 4, 1902,	March 4, 1902,	Selling adulterated honey, ...	Criminal.
March 21, 1902,	March 25, 1902,	Selling adulterated hams, ...	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
137,	2009	Wm. Deisroth,	Frank M. Brown,	Wilkes-Barre,
136,	2010	Wm. Deisroth,	Frank M. Brown,	Wilkes-Barre,

Pure Food Case,

W. A. H. 35,	2032	W. R. McKee,	W. W. Cubbison,	New Castle,

Pure Food Cases,

64,	2004	W. B. Hedrick,	O. F. Lenhardt,	Norristown,
62,	2005	M. K. Hunsberger,	O. F. Lenhardt,	Norristown,
63,	2021	H. M. Nice,	O. F. Lenhardt,	Norristown,

Pure Food Case,

S. M. R. 1229,	2072	J. H. Shotwell & Roe Shotwell.	H. S. Drake,	Stroudsburg,

Pure Food Cases,

S. M. R. 1218,	2019	Schneider Bros.,	William Amour,	Mt. Carmel,
S. M. R. 1220,	2020	Schneider Bros.,	William Amour,	Mt. Carmel,
S. M. R. 1193,	2057	Morris Bastian & Wilson Arbugast.	M. P. Cashner,	South Bethlehem,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Luzerne County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Gave judgment in the sum of $50 and costs.		
Gave judgment in the sum of $50 and costs.		

Lawrence County—Continued.

Defdt. plead guilty and paid costs and promised to remove goods from the State.		

Montgomery County—Continued.

Case continued until further notice; defdt. fined $50 and costs.	....	Paid.
Continued, defdt. fined $50 and and $5 analysis cost.	....	Paid.
Awaiting further orders.		

Monroe County—Continued.

Defdt. gave bail for court.		

Northampton County—Continued.

Case suspended on payment of cost; defdt. agreed to send goods back to manufacturer.		
Case suspended on payment of cost; defdt. agreed to send goods back to manufacturer.		
Defdt. plead guilty and paid fine of $50 and costs $2.80.	....	Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
S. M. R. 1194,	2058	Swift & Co.,	Easton,
S. M. R. 1240-1241.	2068	James Weidman,	Bangor,
S. M. S. 1235,	2079	H. G. Tumbler,	Easton,

Pure Food Case,

S. M. R. 1221,	2059	Emanuel Mallick,	Shamokin,

Pure Food Cases,

A. L. 77,	2022	Louis Miltenburg, Mgr., Philadelphia Pickling Co.	Philadelphia,
352 L.,	2030	B. Taxstem,	1238 South St., Phila.,
389 L.,	2031	Shaporo Bros.,	2, 4 and 6 Queen St., Phila.,
368 L.,	2029	Henry Rohner,	5th and Race Sts., Phila.,
P. H. S. 122,	2064	William Poellman,	2440 N. 15th St., Phila.,
396 L.,	2065	William Strange,	307 N. 2d St., Phila.,
J. M. S. 348,	2062	Saml. Forsyth & Co.,	13th and South Sts., Phila.,
J. M. S. 383,	2063	A. F. Bickley & Son,	529 N. 2d St., Phila.,
J. M. S. 375, L. 441.	2074	Thomas Hunter,	1624 S. 10th St., Phila.,
J. M. S. 384, L. 450.	2087	Robert J. Milligan,	3651 Market St., Phila.,
101,	2116	Weikel & Smith Spice Co.,	Philadelphia,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Northampton County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
March 21, 1902,	March 25, 1902,	Selling adulterated hams, ...	Criminal.
April 17, 1902,	April 17, 1902,	Selling adulterated honey and strawberry jelly,	Criminal.
April 24, 1902,	April 24, 1902,	Selling adulterated maple syrup, ...	Criminal.

Northumberland County.

March 19, 1902,	April 19, 1902,	Selling adulterated pepper, ...	Criminal.

Philadelphia County.

March 8, 1902,	March 15, 1902,	Selling adulterated maple syrup, ...	Criminal.
March 9, 1902,	March 15, 1902,	Selling adulterated raspberry jam, ...	Criminal.
March 9, 1902,	March 15, 1902,	Selling adulterated cider, ...	Criminal.
March 9, 1902,	March 15, 1902,	Selling adulterated gooseberry jam, ...	Criminal.
March 29, 1902,	April 2, 1902,	Selling adulterated orange extract, ...	Criminal.
March 29, 1902,	April 2, 1902,	Selling adulterated cocoa, ...	Criminal.
March 29, 1902,	April 2, 1902,	Selling adulterated honey, ...	Criminal.
March 29, 1902,	April 2, 1902,	Selling adulterated butter, ...	Criminal.
April 21, 1902,	April 29, 1902,	Selling adulterated molasses, ...	Criminal.
April 30, 1902,	May 6, 1902,	Selling adulterated molasses, ...	Criminal.
May 26, 1902,	May 29, 1902,	Selling adulterated pepper, ...	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
S. M. R. 1194,	2058	Swift & Co., ...	M. P. Cashner, ...	South Bethlehem, ...
S. M. R. 1240-1241.	2068	James Weidman, ...	G. H. Getter, ...	South Bethlehem, ...
S. M. S. 1235,	2079	H. G. Tumbler, ...	G. H. Getter, ...	South Bethlehem, ...

Pure Food Case,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
S. M. R. 1221,	2059	Emanuel Mallick, ...	John J. W. Schwartz,..	Shamokin, ...

Pure Food Cases,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
A. L. 77, ...	2022	Louis Miltenburg, Mgr. Phila. Pickling Co.	H. R. Stratton, ...	Philadelphia, ...
352 L., ...	2030	B. Taxstem.	H. R. Stratton, ...	Philadelphia, ...
389 L., ...	2031	Shaporo Bros., ...	H. R. Stratton, ...	Philadelphia, ...
368 L., ...	2029	Henry Rohner, ...	H. R. Stratton, ...	Philadelphia, ...
P. H. S. 122,	2064	William Poellman, ...	H. R. Stratton, ...	Philadelphia, ...
396 L., ...	2065	William Strange, ...	H. R. Stratton, ...	Philadelphia, ...
J. M. S. 348,	2062	Saml. Forsyth & Co.,..	H. R. Stratton, ...	Philadelphia, ...
J. M. S. 383,	2063	A. F. Bickley & Son,	H. R. Stratton, ...	Philadelphia, ...
J. M. S. 375, L. 441.	2074	Thomas Hunter, ...	H. R. Stratton, ...	Philadelphia, ...
J. M. S. 384, L. 450.	2087	Robert J. Milligan, ...	H. R. Stratton, ...	Philadelphia, ...
101, ...	2116	Weikel & Smith, Spice Co.	H. R. Stratton, ...	Philadelphia, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Northampton County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Defdt. plead guilty; paid $50 and costs $5.10 analysis fee and $2.80 costs.	....	Paid.
Defdt. plead guilty and paid fine of $50 and analysis fee of $10.	....	Paid.
Defdt. plead guilty and paid fine of $50 and $5 costs.	....	Paid.

Northumberland County—Continued.

Defdt. waived hearing.		

Philadelphia County—Continued.

Case continued.		
Held defdt. for $400 bail for court.		
Held defdt. for $400 bail for court.		
Magistrate remitted fine and made defdt. pay costs on account of manufacturer of goods using no miner preservatives.		
Hearing continued; magistrate discharged defdt. on account of witness being late.		
Defdt. fined $50 and $8.50 costs; which were paid.	....	Paid.
Continued the hearing.		
Postponed for one week.		
Defdt. waived hearing and entered bail for court.		
Held case under advisement; defdt. $300 bail for court.		

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
165,	2103	A. Weinfield,	549 N. 2d St., Phila.,
534 L.,	2111	George M. Dunlap,	1816 S. 2d St.,
J. M. S. 428, L. 496.	2114	Wm. J. Strange,	4435 Frankford Av., Phila.,
J. M. S. 364, L. 430.	2104	Donohoe Bros.,	3520 Market St., Phila.,
L. 335,	2073	Strawbridge & Clothier,	8th and Market Sts., Phila.,
J. M. S. 431, L. 499.	2107	Robt. J. Milligan,	4507 Frankford Av., Phila.,
J. M. S. 426, L. 494.	2105	Joseph W. Ennis,	29th and Stiles Sts., Phila.,
J. M. S. 369, L. 435.	2109	Thomas Hunter,	19th and Market Sts., Phila.,
418 L.,	2110	William Butler Co.,	11th and Jackson Sts., Phila.,
J. M. S. 386 L. 452.	2113	William Butler Co.,	3528 Market St., Phila.,
48,	2124	H. Read & Co.,	Philadelphia,

Pure Food Cases,

S. M. R. 1209	2018	J. Z. Backenstose,	Mahanoy City,
S. M. R. 1225,	2088	George E. Farne,	St. Clair,
S. M. R. 1219,	2089	Michael C. Ford,	Girardville,
S. M. R. 1248 B.	2099	S. F. Herb, Ora Herb,	Tremont,
S. M. R. 1226,	2128	A. C. Davenport, Mgr. Schuylkill Supply Co.	St. Clair,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Philadelphia County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
May 28, 1902,	June 3, 1902,	Selling adulterated honey,	Criminal.
May 29, 1902,	June 3, 1902,	Selling adulterated syrup,	Criminal.
May 29, 1902,	June 3, 1902,	Selling adulterated molasses,	Criminal.
May 29, 1902.	June 3, 1902,	Selling adulterated honey,	Criminal.
April 21, 1902,	April 29, 1902,	Selling adulterated orange extract,	Criminal.
May 29, 1902,	June 3, 1902,	Selling adulterated molasses,	Criminal.
May 29, 1902,	June 3, 1902,	Selling adulterated molasses,	Criminal.
May 29, 1902,	June 3, 1902,	Selling adulterated maple syrup,	Criminal.
May 29, 1902,	June 3, 1902,	Selling adulterated chocolate,	Criminal.
May 29, 1902,	June 3, 1902,	Selling adulterated molasses,	Criminal.
June 17, 1902,	June 24, 1902,	Selling adulterated pepper,	Criminal.

Schuylkill County.

March 3, 1902,	March 4, 1902,	Selling adulterated pepper,	Criminal.
April 28, 1902,	April 29, 1902,	Selling adulterated honey,	Criminal.
April 30, 1902,	May 5, 1902,	Selling adulterated pepper,	Criminal.
May 14, 1902,	May 15, 1902,	Selling adulterated pepper,	Criminal.
June 30, 1902,	July 1, 1902,	Selling adulterated honey,	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.			Magistrate.	
Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
165,	2103	A. Weinfield,	H. R. Stratton,	Philadelphia,
534 L.,	2111	George M. Dunlap,	H. R. Stratton,	Philadelphia,
J. M. S. 428, L. 496.	2114	Wm. J. Strange,	H. R. Stratton,	Philadelphia,
J. M. S. 364, L. 430.	2104	Donohoe Bros.,	H. R. Stratton,	Philadelphia,
L. 335,	2073	Strawbridge & Clothier,	H. R. Stratton,	Philadelphia,
J. M. S. 431, L. 499.	2107	Robt. J. Milligan,	Henry R. Stratton,	Philadelphia,
J. M. S. 426, L. 494.	2105	Joseph W. Ennis,	Henry R. Stratton,	Philadelphia,
J. M. S. 369, L. 435.	2109	Thomas Hunter,	Henry R. Stratton,	Philadelphia,
418 L.,	2110	William Butler Co.,	Henry R. Stratton,	Philadelphia,
J. M. S. 386 L. 452.	2113	William Butler Co.,	Henry R. Stratton,	Philadelphia,
48,	2124	H. Read & Co.,	Henry R. Stratton,	Philadelphia,

Pure Food Cases,

S. M. R. 1209	2018	J. Z. Backenstose,	Richard T. Lewis,	Mahanoy City,
S. M. R. 1225,	2088	George E. Farne,	J. W. Conrad,	Pottsville,
S. M. R. 1219,	2089	Michael C. Ford,	Richard T. Lewis,	Mahanoy City,
S. M. R. 1248 B.	2099	S. F. Herb, Ora Herb,	D. H. Fister,	Pottsville,
S. M. R. 1226,	2128	A. C. Davenport, Mgr. Schuylkill Supply Co.	D. H. Fister,	Pottsville,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Philadelphia County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Held defdt. for court in $400 bail or $50 fine and costs.		
Defdt. plead guilty and magistrate imposed fine of $50 and $7.50 costs.	....	Paid.
Defdt. fined $50 costs and $9 costs.	....	Paid.
Postponed one week; June 7, 1902, defdts. plead guilty and paid fine of $50 and $8.50 costs.	....	Paid.
Defdt. was fined $50 and $8 costs.		

Schuylkill County—Continued.

Defdt. bound over to court, ...	Deft. plead guilty in court; fine $50 and costs of $18.82.	Paid.
Held for court, ...	Deft. plead guilty in case was adjusted, his attorneys upon payment of costs.	Paid.
Defdt. gave bail for court, ...	Deft. plead guilty and paid fine of $50 and $5.36 costs.	Paid.
Defdt. was bound over to court, ..	Case settled on payment of costs of $5 analysis fee by district attorney.	Paid.
Bound defdt. over to September term of court.		

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
268 F.,	1982	Henry Fresli, Elk Lick Supply Co.,	Salisbury,
431 F.,	1986	A. L. Hill,	Windber,
358 F.,	1985	J. H. Judy,	Garrett,

Pure Food Cases,

H. L. B. 246,	2026	Robert Crable,	Washington,
H. L. B. 247,	2027	Byron C. Braden,	194 S. Main St., Washington,
H. L. B. 250,	2028	Fred. Baumbarger,	220 W. Chestnut St., Washington.,
P. 774,	2036	J. W. Day & J. B. Hughes,	304 S. Main St., Washington,

Pure Food Case,

W. A. H. 5,	2008	T. P. Hensler,	Irwin,

Pure Food Case,

166,	2130	Chas. F. Carman,	Lacyville,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Somerset County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
Jan. 9, 1902,	Feb. 1, 1902,	Selling adulterated French peas,	Criminal.
Jan. 9, 1902,	Feb. 1, 1902,	Selling adulterated lemon extract,	Criminal.
Jan. 9, 1902,	Feb. 1, 1902,	Selling adulterated pepper,	Criminal.

Washington County.

March 7, 1902,	March 17, 1902,	Selling Weiner sausage containing preservatives and colored.	Criminal.
March 8, 1902,	March 17, 1902,	Selling minced ham artificially colored,	Criminal.
March 8, 1902,	March 17, 1902,	Selling sausage containing preservatives and coloring.	Criminal.
March 19, 1902,	March 26, 1902,	Selling adulterated lemon extract,	Criminal.

Westmoreland County.

Feb. 6, 1902,	Feb. 15, 1902,	Violation of pure food law,	Criminal.

Wyoming County.

June 16, 1902,	June 21, 1902,	Selling mixed butter,	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Pure Food Cases,

Sample.			Magistrate.	
Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
268 F.,	1982	Henry Fresli, Elk Lick Supply Co.	J. H. Pisel,	Somerset,
431 F.,	1986	A. L. Hill,	J. H. Pisel,	Somerset,
358 F.,	1985	J. H. Judy,	J. H. Pisel,	Somerset,

Pure Food Cases,

H. L. B. 246,	2026	Robert Crable,	D. M. Donehoo,	Washington,
H. L. B. 247,	2027	Byron C. Braden,	D. M. Donehoo,	Washington,
H. L. B. 250,	2028	Fred. Baumbarger,	D. M. Donehoo,	Washington,
P. 774,	2036	J. W. Day & J. B. Hughes.	D. M. Donehoo,	Washington,

Pure Food Case,

W. A. H. 5,	2008	T. P. Hensler,	John B. Eicher,	Greensburg,

Pure Food Case,

166,	2130	Chas. F. Carman,	Squire Hutz,	Tunkhannock,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Somerset County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Held for court,	Court ordered jury to bring verdict of acquittal; see report on this case.	
Held for court,	Deft. plead not guilty; jury rendered verdict of not guilty; county to pay costs.	
Defdt. fined $50 and costs,		Paid.

Washington County—Continued.

Waived hearing and magistrate imposed $50 and costs.		Paid.
Waived hearing and magistrate imposed $50 and costs.		Paid.
Waived hearing and magistrate imposed $50 and costs.		Paid.
Criminal suit withdrawn; civil proceedings entered; deft. plead guilty; fine $50 and $4.50 costs.		Paid.

Westmoreland County—Continued.

Deft. discharged on account of lack of evidence; county pay costs.		

Wyoming County—Continued.

Case discharged by magistrate as not sufficient cause for holding.		

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Renovated Butter Case,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
F. 472, ...	2096	John Schmittel, ...	Altoona, ...

Renovated Butter Case,

S. M. S. 1244,	2067	James Christman, ...	Leighton, ...

Renovated Butter Case,

F. 495, ...	2100	John Benson, ...	Houtzdale, ...

Renovated Butter Case,

L. 457, ...	2066	Maurice C. Eby, ...	Harrisburg, ...

Renovated Butter Cases,

163, ...	2006	J. J. Huggins, ...	Carbondale, ...
S. J. S. 165, S. 163.	2011	M. P. O'Connor, ...	Newark, N. J., ...
H. L. B. 261,	2123	Wm. Mavel, ...	Scranton, ...

Renovated Butter Cases,

128, ...	2090	David R. Bradley, ...	Bradford, ...
130, ...	2091	David R. Bradley, ...	Bradford, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Blair County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
April 11, 1902,		Selling renovated butter,	Criminal.

Carbon County.

April 15, 1902,	April 24, 1902,	Selling renovated butter,	Criminal.

Clearfield County.

May 13, 1902,		Selling renovated butter,	Criminal

Dauphin County.

pril 4, 1902,	April 11, 1902,	Selling renovated butter,	Civil.

ackawanna County.

b. 1, 1902,	Feb. 7, 1902,	Selling renovated butter,	Civil.
b. 19, 1902,	Feb. 19, 1902,	Selling renovated butter,	Criminal.
ne 9, 1902,	June 13, 1902,	Selling renovated butter,	Civil.

Kean County.

ril 22, 1902,	April 24, 1902,	Selling renovated butter,	Criminal.
il 22, 1902,	April 24, 1902,	Selling renovated butter,	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Renovated Butter Case,

Sample.			Magistrate.	
Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
F. 472, ...	2096	John Schmittel, ...	David P. Hart, ...	Altoona, ...

Renovated Butter Case,

S. M. S. 1244,	2067	James Christman, ...	J. A. Beltz, ...	Leighton, ...

Renovated Butter Case,

F. 495, ...	2100	John Benson, ...	P. Gallagher, ...	Osceola, ...

Renovated Butter Case,

L. 457, ...	2066	Maurice C. Eby, ...	S. Brady Caveny, ...	Harrisburg, ...

Renovated Butter Cases,

163, ...	2006	J. J. Huggins, ...	M. Kasson, ...	Scranton, ...
S. J. S. 165, S. 163.	2011	M. P. O'Connor, ...	M. Kasson, ...	Scranton, ...
H. L. B. 261,	2123	Wm. Mavel, ...	M. Kasson, ...	Scranton, ...

Renovated Butter Cases,

128, ...	2090	David R. Bradley, ...	B. L. Knapp, ...	Smithport, ...
130, ...	2091	David R. Bradley, ...	B. L. Knapp, ...	Smithport, ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Blair County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Magistrate dismissed case upon payment of costs by deft. owing to the sickness and poverty of deft.		

Carbon County—Continued.

Clearfield County—Continued.

Waived hearing and entered bail for court.		

Dauphin County—Continued.

Lackawanna County—Continued.

Judgment for $100 and costs; case withdrawn upon payment of costs; information made against M. O'Connor.		
Waived hearing and entered bail for court.		
Case dismissed and information made against Chas. F. Carmen, Lacyville, Pa.		

McKean County—Continued.

Held in $300 bail for court.		
Held in $300 bail for court.		

Renovated Butter Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
131,	2092	M. A. Nusbaum,	Bradford,
135,	2093	J. Heavnor,	Port Allegany,

Renovated Butter Cases,

S. M. R. 1231,	2060	A. D. Landis,	Tannersville,
S. M. R. 1233,	2061	A. D. Landis,	Tannersville,
S. M. R. 1228,	2071	J. H. Shotwell & Roe Shotwell,	Stroudsburg,

Renovated Butter Case,

S. M. R. 1248,	2098	D. H. Snyder, N. Snyder & H. Moore.	Sunbury,

Renovated Butter Cases,

390 L.,	2069	M. S. Stienburg,	613 S. 2d St., Phila.,
J. M. S. 378, L. 458.	2075	Louis Scheurer,	730 S. Second St., Phila.,
504 L.,	2076	J. Buschel & J. Ferguson,	739 S. 2d St., Phila.,
157,	2101	Walt. Gingrich,	5 S. 3d St., Phila.,
170,	2102	Gilberstein & Rosenfild,	246 Market St., Phila.,
H. L. B. 263,	2122	Nice & Schrieber,	19 and 21 Market St., Phila.,
L. 452-521,	2106	J. E. DeCon Salmon and Cumberland.	Philadelphia,

Renovated Butter Cases,

S. M. R. 1204,	2014	William J. Miles,	Mahanoy City,
S. M. R. 1247,	2097	Geo. M. Hunzinger,	Tremont,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

McKean County—Continued.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
April 22, 1902,	April 24, 1902,	Selling renovated butter,	Criminal.
April 22, 1902,	April 24, 1902,	Selling renovated butter,	Criminal.

Monroe County.

March 25, 1902,	March 26, 1902,	Selling renovated butter,	Criminal.
March 25, 1902,	March 26, 1902,	Selling renovated butter,	Criminal.
April 22, 1902,	April 23, 1902,	Selling renovated butter,	Criminal.

Northampton County.

May 15, 1902,	May 16, 1902.	Selling renovated butter,	Civil.

Philadelphia County.

April 13, 1902,	April 21, 1902,	Selling renovated butter; no license,	Criminal.
April 2, 1902,	April 14, 1902,	Selling renovated butter; no license,	Criminal.
April 21, 1902,	April 29, 1902,	Selling renovated butter,	Civil.
May 28, 1902,	June 3, 1902,	Selling renovated butter,	Civil.
May 28, 1902,	June 3, 1902,	Selling renovated butter,	Civil.
May 27, 1902,	June 3, 1902,	Selling renovated butter,	Civil.
May 29, 1902,	June 3, 1902,	Selling renovated butter,	Criminal.

Schuylkill County.

March 3 , 1902,	March 3, 1902,	Selling renovated butter,	Criminal.
May 15, 1902,	May 16, 1902,	Selling renovated butter,	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Renovated Butter Cases,

Sample.			Magistrate.	
Agent's number and mark.	Docket number.	Name—Defendant.	Name.	Address.
131,	2092	M. A. Nusbaum,	B. L. Knapp,	Smethport,
135,	2093	J. Heavnor,	B. L. Knapp,	Smethport,

Renovated Butter Cases,

S. M. R. 1231,	2060	A. D. Landis,	Robt. Grurer,	Stroudsburg,
S. M. R. 1233,	2061	A. D. Landis,	Robt. Grurer,	Stroudsburg,
S. M. R. 1228,	2071	J. H. Shotwell & Roe Shotwell.	H. S. Drake,	Stroudsburg,

Renovated Butter Case,

S. M. R. 1248,	2098	D. H. Snyder, N. Snyder & H. Moore.	Walter Shipman,	Sunbury,

Renovated Butter Cases,

390 L.,	2069	M. S. Stienburg,	H. R. Stratton,	Philadelphia,
J. M. S. 378, L. 458.	2075	Louis Scheurer,	H. R. Stratton,	Philadelphia,
504 L.,	2076	J. Buschel & J. Gerguson.	H. R. Stratton,	Philadelphia,
157,	2101	Walt Gingrich,	H. R. Stratton,	Philadelphia,
170,	2102	Gilberstein & Rosenfild.	H. R. Stratton,	Philadelphia,
H. L. B. 263,	2122	Nice & Schhieber,	H. R. Stratton,	Philadelphia,
L. 452-521,	2106	J. E. DeCon Salmon and Cumberland.	H. R. Stratton,	Philadelphia,

Renovated Butter Cases,

S. M. R. 1204,	2014	William J. Miles,	Richard Lewis,	Mahanoy City,
S. M. R. 1247,	2097	Geo. M. Hunzinger,	D. H. Fisher,	Pottsville,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

McKean County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final
Held in $300 bail for court.		
Held in $300 bail for court.		

Monroe County—Continued.

Held in $300 bail for court.		
Held for court.		
Defts. gave bail for court.		

Northampton County—Continued.

Continued to May 21; deft. plead guilty and paid a fine of $100 and $9.52.		

Philadelphia County—Continued.

Judgment for $100 and costs.		
Held for court in $400 bail.		
Defts. were fined $8.50 costs.	....	Paid.
Judgment for $100 and costs.		

Schuylkill County—Continued.

Deft. bound over to court in $300 bail.		
Deft. waived hearing and entered bail for court.	Case nol pros. upon payment of $50 analysis fee.	Paid.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Renovated Butter Case,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
H. L. B. 261,	2129	Chas. F. Carman, ...	Lacyville, ...

Vinegar Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
713 P., ...	2085	Albert Snyder, ...	2903 Carson St., S. S., Pittsburg, ...
307 M., ...	2117	William Turner, ...	809 Penn Av., Wilkinsburg, ...

Vinegar Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
S. M. R. 1243,	2095	J. A. Eberts, ...	Bethlehem, ...
S. M. R. 1250,	2118	J. A. Eberts & Co., ...	Bethlehem, ...
S. M. R. 1251,	2119	J. A. Eberts & Co., ...	Bethlehem, ...

Vinegar Cases,

Sample.		Defendant.	
Agent's number and mark.	Docket number.	Name.	Address.
471 L., ...	2112	Turchie Bros., ...	843 Washington Av., Phila., ...
J. M. S. 425, L. 493.	2086	Jos. W. Ennis, ...	29th and Stiles Sts., Phila., ...

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Wyoming County.

Suit.			
Begun.	Date of Hearing.	Charge.	Form of action.
June 16, 1902,	June 21, 1902,	Selling renovated butter, ...	Civil.

Allegheny County.

Begun.	Date of Hearing.	Charge.	Form of action.
April 30, 1902,	May 7, 1902,	Selling adulterated cider vinegar, ...	Criminal.
May 29, 1902,	June 5, 1902,	Selling pineapple cider vinegar, spurious, ...	Criminal.

Northampton County.

Begun.	Date of Hearing.	Charge.	Form of action.
May 12, 1902,	May 12, 1902,	Selling adulterated vinegar, ...	Criminal.
May 28, 1902,	May 28, 1902,	Selling adulterated vinegar, ...	Criminal.
May 28, 1902,	May 28, 1902,	Selling adulterated vinegar, ...	Criminal.

Philadelphia County.

Begun.	Date of Hearing.	Charge.	Form of action.
May 29, 1902,	June 3, 1902,	Selling adulterated vinegar, ...	Criminal.
April 30, 1902,	May 6, 1902,	Selling adulterated vinegar, ...	Criminal.

DAIRY AND FOOD DIVISION, TABULATED STATEMENT OF SUITS AND

Renovated Butter Case,

Sample.		Name—Defendant.	Magistrate.	
Agent's number and mark.	Docket number.		Name.	Address.
H. L. B. 261,	2129	Chas. F. Carman,	W. Kutz,	Tunkhannock,

Vinegar Cases,

713 P.,	2085	Albert Snyder,	J. V. McMasters,	Grant St., Pittsburg,
307 M.,	2117	William Turner,	J. V. McMasters,	Grant St., Pittsburg,

Vinegar Cases,

S. M. R. 1243,	2095	J. A. Eberts,	Geo. L. Brown,	Bethlehem,
S. M. R. 1250,	2118	J. A. Eberts & Co.,	Geo. L. Brown,	Bethlehem,
S. M. R. 1251,	2119	J. A. Eberts & Co.,	Geo. L. Brown,	Bethlehem,

Vinegar Cases,

471 L.,	2112	Turchie Bros.,	Henry R. Stratton,	Philadelphia,
J. M. S. 425, L. 493.	2086	Jos. W. Ennis,	Henry R. Stratton,	Philadelphia,

PROSECUTIONS, FROM JANUARY 1, 1902, TO JUNE 30, 1902—Continued.

Wyoming County—Continued.

Disposition of the Case.		
By Magistrate.	By the Court.	Final.
Judgment and costs.		

Allegheny County—Continued.

Held for court. Rendered judgment in $100 and costs.		

Northampton County—Continued.

Deft. plead guilty and paid fine of $50 and $9.85 costs.	....	Paid.
Magistrate accepted $5 analysis fee upon deft. agreeing to remove goods from market.	....	Paid.
Magistrate accepted $5 analysis fee upon deft. agreeing to remove goods from the market.	....	Paid.

Philadelphia County—Continued.

Continued to May 20, 1902; deft. plead guilty and was fined $50 and costs.	....	Paid.

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN NO. 101.

TABULATED ANALYSES

OF

COMMERCIAL FERTILIZERS

FROM

SAMPLES SELECTED IN ACCORDANCE WITH ACT OF MARCH 25, 1901,

BY THE

Pennsylvania Department of Agriculture.

FROM JANUARY 1st, 1902, TO AUGUST 1st, 1902.

WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA.
1902.

DEPARTMENT OF AGRICULTURE.
COMMONWEALTH OF PENNSYLVANIA.
VIRTUE LIBERTY AND INDEPENDENCE

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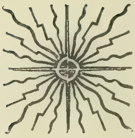


AN ACT

To regulate the manufacture and sale of commercial fertilizers.

Section 1. Be it enacted, &c., That every package of commercial fertilizer sold, offered, or exposed for sale, for manurial purposes, within this Commonwealth, shall have plainly stamped thereon the name of the manufacturer, the place of manufacture, the net weight of its contents, and an analysis stating the percentage therein contained of nitrogen in an available form, of potash soluble in water, of soluble and reverted phosphoric acid and of insoluble phosphoric acid: Provided, That any commercial fertilizer sold, offered, or exposed for sale, which shall contain none of the above named constituents shall be exempt from the provisions of this act.

Section 2. That every manufacturer or importer of commercial fertilizers as specified in section one of this act shall, on or before the first day of January next ensuing, or before offering them for sale in this Commonwealth, file annually with the Secretary of Agriculture an affidavit showing the amount of said fertilizer sold within the Commonwealth during the last preceding year; and if the said amount shall be one hundred tons or less, he shall pay to the Treasurer of the State the sum of fifteen dollars for each and every brand of such commercial fertilizer sold within the State during the last preceding year; and if the said amount shall exceed one hundred tons, and be less than five hundred tons, he or they shall pay the sum of twenty dollars, as aforesaid; and if the said amount shall be five hundred tons or more, he or they shall pay the sum of thirty dollars, as aforesaid. If such manufacturer or manufacturers, importer or importers, shall not have made any sales within the Commonwealth during the preceding year, he or they shall pay the sum of fifteen dollars, as aforesaid. Every said manufacturer shall, at the same time, file with the Secretary of Agriculture a copy of the analysis required by section one of this act, and shall then be entitled to receive from the Secretary of Agriculture a certificate showing that the provisions of this act have been complied with.

Section 3. The Secretary of Agriculture is hereby empowered to collect samples of commercial fertilizers, either in person or by his duly qualified agent or representatives, and to have them analyzed, and to publish the results for the information of the public.

Section 4. The Secretary of Agriculture, and such assistants, agents, experts, chemists, detectives and counsel as he shall duly authorize for the purpose, shall have full access, ingress and egress to all places of business, factories, farms, buildings, carriages, cars and vessels, used in the manufacture, transportation or sale of any commercial fertilizer. They shall also have power to open any package or vessel containing or supposed to contain any commercial fertilizer, and to take therefrom samples for analysis upon tendering the value of said samples.

Section 5. Any person selling, offering, or exposing for sale, any commercial fertilizer without the analysis required by section one of this act, or with an analysis stating that it contains a larger percentage of any one or more of the above named constituents than is contained therein, or for the sale of which all the provisions of section two have not been complied with, shall be guilty of misdemeanor, and on conviction shall forfeit a sum not less than twenty-five and not exceeding one hundred dollars for the first offense, and not less than two hundred dollars for each subsequent offense. It shall be the duty of the Secretary of Agriculture to enforce the provisions of this act, and all penalties, costs and fines recovered shall be paid to him or his duly authorized agent, and by him be immediately paid into the State Treasury, to constitute a special fund to be used in accordance with the provisions of section six of this act.

Section 6. The money paid into the Treasury under the provisions of this act shall constitute a special fund, from which the cost of selecting samples, making analyses, and other expenses incident to the carrying into effect the provisions of this act, shall be paid: Provided, That the total amount thus expended shall in no case exceed the amount paid into the Treasury.

Section 7. The term "commercial fertilizers," as used in this act, shall be taken to mean any and every substance imported, manufactured, prepared or sold for fertilizing or manuring purposes, except barnyard manure, marl, lime, and wood ashes, and not exempt by the provisions of section one of this act.

Section 8. This act shall go into effect on and after the thirty-first day of December, one thousand nine hundred and one. All acts or parts of acts inconsistent with this act are hereby repealed, except that existing laws are to continue in force until this act goes into effect.

Approved—The 25th day of March, A. D. 1901.

PREFACE.

Harrisburg, Pa., August 1, 1902.

The following Bulletin, No. 101, containing analyses of samples of Commercial Fertilizers, collected by the agents of the Department of Agriculture from January 1, to August 1, 1902, is herewith presented, for the information of the public.

The usual discussion by the Chemist, of changes in the prices of the ingredients of fertilizers, which have occurred since August 1, 1901, is appended, together with a schedule of prices fixed for the current year.

The foot notes refer to the page where the appropriate list of prices may be found; and farmers are urged to use these data, and compute for themselves, the value of the composition which they expect to purchase.

The attention of manufacturers and dealers in Commercial Fertilizers, is called to the new law, which is printed for information in this bulletin. The law changes the license fee from ten dollars to fifteen dollars for sales of one hundred tons or less, of each and every brand sold within the State the previous year. The powers of the Secretary of Agriculture, in the matter of enforcing the law, have been enlarged.

Manufacturers in sending in their list of brands of fertilizers sometimes use a slightly different wording on their sacks from that furnished this Department. Agents of the Department in reporting are required to copy the precise words used on the sack. If any change has been made in branding, from the designation sent to this office, we regard the brand so changed as UNLICENSED, and a separate license must be taken out.

Manufacturers are, therefore, cautioned to use the exact language in marking the sacks, that they have furnished to the Department for record.

Commercial fertilizers are now a recognized necessity in the agriculture of Pennsylvania, and our farmers will have to post themselves as to the action of the various substances that compose them, or pay the penalty which is always exacted from ignorance. There was a time when the farmer could not know what to purchase, or how to purchase. That time is past, and if he is deceived now, it is his own fault. Full information is at his disposal if he will take and use it.

JOHN HAMILTON,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

The Pennsylvania State College Agricultural Experiment Station,
State College, Pa., August 1, 1902.

Hon. John Hamilton, Secretary of Agriculture, Harrisburg, Pa.:

Sir: I have the honor to transmit herewith a tabulated statement of the analyses of the fertilizer samples, submitted by the agents of the Department for the period from January 1st to August 1st, 1902. A parallel statement of the guaranties, filed by the manufacturers, accompanies the report. There is prefixed a review of the wholesale markets in fertilizer ingredients during the principal purchasing season affecting this year's trade, and an exposition of the principles adopted in estimating the comparative commercial value of the several brands analyzed.

Very respectfully,

WM. FREAR.

FERTILIZER VALUATIONS—1902.

The object of an official valuation of commercial fertilizers is to enable the consumer to judge approximately whether he has been asked to pay for a given brand more than the fertilizing ingredients it contains and market conditions prevailing at the time would warrant. It is clear, therefore, that no attempt is made in this valuation to indicate whether the fertilizer valued possesses a greater or less crop-producing capacity than another fertilizer; but only whether it is higher priced than another of the same general composition.

For this purpose it must be so computed as to include all the elements entering into the cost of a fertilizer as it is delivered to the consumer. These elements may be conveniently grouped as follows:

1. The wholesale cost of the ingredients.
2. The jobbers' gross profit on the sale of the ingredients; this includes office expenses, advertising, losses, etc.; for the purpose of the present computation it may be assumed that the sum of this gross profit and the wholesale cost of the ingredients, is equivalent to the retail price of the single ingredients near the wholesale markets in ton lots of original packages for cash.
3. The expense and profit of mixing: This item applies only to complete fertilizers, rock and potash, and ammoniated rock; not to dissolved or ground bone, or to dissolved rock.
4. The expense and profit of bagging.
5. Agents' commission: This item includes not only the commission proper, but every advance in price due to the sale of the goods through an agent in small quantities on time, rather than directly to the consumer in ton lots for cash.
6. Freight from the wholesale market to the point of delivery.

The valuations for 1901 were based:

1. Upon the wholesale prices from September 1, 1900, to March 1, 1901, of the raw materials used in fertilizer manufacture, the quotations of the New York market being adopted for all materials except acidulated phosphate rock and ground bone.
2. Upon an allowance of 20 per cent. of the wholesale prices, above mentioned, to cover jobbers' profits.

By adding the 20 per cent. allowed for jobbers' gross profit to the wholesale price of the several raw materials, the retail price in original packages at the jobbers' warehouse is obtained.

Since the amount of the several valuable fertilizing constituents in the various raw materials is known, it is a simple matter to determine the corresponding retail value per pound of the valuable fertilizing constituents yielded by each raw material. A schedule of these pound values affords a convenient basis of computation of the value per ton of various fertilizers, whose composition is ascertained by analysis.

The values assigned, for the present, to the other elements in the cost of the fertilizer at the point of delivery are:

3. For mixing, $1.00 per ton.

4. For bagging, $1.00 per ton, in all cases except those in which the article was sold in original package; the cost of the package being, in such cases, included in the wholesale price.

5. For agents' commissions, 20 per cent. of the cost of the goods f. o. b. at the jobbers' or mixers' warehouse.

6. For freight, $2.00 per ton; the cost of the freight in lots of twelve tons or over, from the seaboard to Harrisburg, averaging $1.88 per ton.

The following valuation of dissolved South Carolina rock illustrates the method:

Phosphoric acid.	Per cent.	Weight per ton.	
Soluble,	11.50	230 lbs. at 3c.	$6 90
Reverted,	2.50	50 lbs. at 2½c.	1 25
Insoluble,	1.00	20 lbs. at 1½c.	30
Retail cash value of ingredients,			$8 45
Bagging,			1 00
Cash value of goods ready for shipment,			$9 45
Agents' commission, 20 per cent.,			1 89
Freight,			2 00
Commercial value per ton,			$13 34

It is not to be expected, of course, that the valuations thus computed will precisely represent the fair price to be charged for a brand in each locality and in every transaction. Market conditions, competition, distance from factory, all introduce minor variations. Nevertheless, to make the approximation reasonably close, the average valuation of a given class of goods ought to agree closely with its ascertained average selling price. Whenever such an agreement is no longer obtained by the use of a schedule, it is evident that the schedule of retail values of the constituents, or the added allowances for mixing, etc., requires revision.

It is needful to note here another factor greatly affecting the practical accuracy of these approximations. Their computation would offer little difficulty and their usefulness be far greater, if, by the ordinary methods of analysis, the exact nature of the ingredients used to supply the several fertilizer constituents, were capable of certain determination. This is, however, possible, to-day, to only a limited extent. The valuations are, therefore, based on the assumption that the fertilizers are uniformly compounded from high quality ingredients, such as are commonly employed in the manufacture of fertilizers of the several classes. Consumers should carefully avoid the error of accepting such valuations as infallible; they are not designed to be used for close comparison of single brands, but only to indicate whether the price asked for a fertilizer is abnormal, assuming good quality for the ingredients used. From this it is clear that, except as high freights may require, the selling price of a brand should not far exceed the valuation; but that a fertilizer may be made of inferior materials and yet have a high valuation.

The valuations used during 1900 were modified for use during 1901 in accordance with the changes in wholesale prices of fertilizing ingredients and to make the valuations more closely follow the selling price.

The following comparative statement shows the valuations and selling prices of the several classes of fertilizers during 1900 and 1901.

Fertilizers.	Number of samples.	Valuation.	Selling price.	Difference of valuation from selling price.
Spring, 1900.				
Complete,	276	24.61	25.38	—0.77
Rock-and-potash,	48	14.71	17.25	—2.64
Dissolved bone,	2	30.87	26.00	4.87
Ground bone,	30	25.91	28.42	—2.51
Dissolved rock,	56	13.48	13.57	—0.09
Fall, 1900.				
Complete,	130	24.00	23.22	0.81
Rock-and-potash,	33	14.63	18.11	—3.48
Dissolved bone,	2	22.74	23.50	—0.76
Ground bone,	17	26.87	28.73	—1.86
Dissolved rock,	31	13.11	13.96	—0.85
Spring, 1901.				
Complete,	291	24.76	23.92	0.84
Rock-and-potash,	60	14.60	16.20	—1.60
Dissolved bone,	1	29.00	28.00	1.00
Ground bone,	44	28.71	27.59	1.12
Dissolved rock,	49	13.51	13.90	—0.39
Fall, 1901.				
Complete,	179	23.75	22.28	1.47
Rock-and-potash,	42	14.23	16.09	—1.86
Dissolved bone,	5	23.36	23.91	—0.55
Ground bone,	33	27.69	25.94	1.75
Dissolved rock,	49	13.82	13.18	0.64

The valuations during 1901 for the more important classes of fertilizers were considerably higher than the selling prices; the difference was more marked in the fall than in the spring. As usual, the selling prices of rock-and-potash maintain a disproportionately high level.

The general tendencies of the wholesale market may be judged from the following comparative statement, obtained from the weekly reports of the Oil, Paint and Drug Reporter, of New York City, showing the average wholesale prices of fertilizer raw materials from September 1, 1900, to March 1, 1901, and from September 1, 1901, to March 1, 1902.

Wholesale Prices of Fertilizer Ingredients, New York: Oil, Paint and Drug Reporter.

Substance.	Amount priced.	Average price Sept., 1900, to March, 1901.	Average price Sept. 1, 1901, to March, 1902.	Prices Sept.-Feb., 1901-2, in per cent. of prices 1900-01.
Sulfate of ammonia,	Cwt.,	2.8005	2,8324	101.1
Nitrate of soda,	Cwt.,	1.8153	1,9889	109.5
Dried blood, H. G.,	Unit (20 lbs.),	2.3127	2.2375	96.7
Concentrated tankage,	Ton,	16.227	16.25	100.1
Rough bone,	Ton,	20.983	18.25	86.9
Ground bone,	Ton,	21.842	20.50	93.8
Bone meal,	Ton,	19.70	17.72	89.9
Fish guano (dry),	Ton,	23.00	24.50	106.5
Fish guano (acid),	Ton,	12.00	13.25	110.4
Refuse bone-black,	Ton,	19.30	19.00	98.4
Phosphate rock (Charleston),	Ton,	7.25	7.48	103.2
Phosphate rock (Tennessee),	Ton,	3.25	3.328	102.4
Acid phosphate,	Unit (20 lbs.),	.6422	.625	97.3
Double manure salts,	Cwt.,	1.0725	1.13	105.4
Sulfate of potash,	Cwt.,	2.07	2.125	102.6
Kainit,	Ton,	9.30	9.05	97.3
Muriate of potash,	Cwt.,	1.8475	1.8475	100.0
Sulfuric acid, 66 —° B.	Cwt.,	1.475	1.573	106.6

In ammoniates, such as dried blood or concentrated tankage, the unit is of ammonia, of which 82.35 per cent. is nitrogen; in acid phosphates, the unit is of phosphoric acid (phosphorus pentoxid).

The nitrogenous materials and animal sources of phosphoric acid show the following changes from last year's prices. Sulfate of ammonia has advanced slightly, while in the case of nitrate of soda and fish guano there has been a distinct advance over last year's figures. Concentrated tankage remains practically the same. Dried blood and refuse bone-black have fallen off slightly; rough bone and bone meal show a marked decrease. The following data are from the monthly reports of Thos. J. White & Co., fertilizer brokers, Baltimore, Md., giving wholesale quotations upon ammoniates.

Wholesale Prices of Ammoniates: Reports of Thos. J. White & Co., Baltimore, Md.

	Prices Sept. to March, 1900-1901.	Prices Sept. to March, 1901-1902.
Sulfate of ammonia, per cwt.		
Foreign, f. o. b. Baltimore,	2.76	2.79
Domestic, f. o. b. Boston,	2.76	†2.75
Ground blood, f. o. b. Chicago, per unit ammonia,	2.12	2.015
Concentrated tankage, f. o. b. Chicago, per unit ammonia,	1.96	1.875
Crushed tankage, f. o. b. Chicago, per ton :		
10 per cent. ammonia, 15 per cent. bone phosphate,	*22.63	20.67
10 per cent. ammonia, 10 per cent. bone phosphate,	*20.375	19.49
Crushed tankage, c. a. f. Baltimore, per unit ammonia,	2.29	2.26
Dried fish, f. o. b. factory, per unit ammonia,	‡2.14	§2.175

†f. o. b. Everett; quotations for September only.
*Lacking December quotations.
‡Lacking December and February quotations.
§Quotations for September only.

The foregoing table indicates the following variations from prices a year ago. Sulfate of ammonia has increased 1 per cent. and the other ammoniates have decreased as follows: Ground blood, 5 per cent.; concentrated tankage, 4 per cent.; crushed tankage, 10½ and 15, and 10 and 10, 8½ per cent., and crushed tankage sold per unit of ammonia 1 per cent.

The Engineering and Mining Journal of New York City, gives quotations of sulfate of ammonia and nitrate of soda for January, 1902, 2.8375 and 1.97 per cwt., respectively, as compared with 2.76 and 1.85 for the same month last year. All these figures are confirmatory of those already quoted showing a slight advance in the wholesale price of ammonium sulfate, a marked advance in the case of nitrate of soda, a shrinkage in the value of blood and tankage and quite a marked decrease in the case of bone.

Of the animal raw materials furnishing phosphoric acid, refuse bone-black only has fallen off somewhat in price. The following summary from the Engineering and Mining Journal shows the prices of rock phosphate. Lower freight rates helped to increase the export trade about 17 per cent., 750,000 tons being shipped as against 619,996 tons in 1900.

Florida Phosphate: The largest business was done in high grade rock, the exports amounting to 428,000 tons or about 80,000 tons more than last year. The chief demand for pebble phosphate was for home consumption, the exports however, being larger than last year. Prices during the year were: for high grade rock (77-80) per cent.) f. o. b. Fernandina, $7.25 in January, $6.75 from February to

November inclusive, and $7.25 in December, making the average for the year $6.83 per ton, this being below the price for 1900. During January and February of this year, the price rose, being quoted during that time at $7.50. Land pebbles (68-73 per cent.) were $4.14 in January, $3.93 from February to September inclusive, $3.75 in October and $3.13 in November and December, making the yearly average $3.80. During January and February of this year prices were $3.00 to $3.25.

Peace River phosphate was less active, 18,790 tons being exported as compared with 21,427 tons last year. The average prices f. o. b. Fernandina, were $2.94 in January, $2.63 from February to October, and $2.38 in November and December, the average for the year being $2.61. During January and February of this year quotations were $2.25 to $2.50.

Tennessee Phosphates: The export trade is growing over 130,000 tons of high grade rock being sent abroad. As a result of competition, prices were lower than in 1900. The f. o. b. prices of export rock were $2.88 in January, $3.25 in February, $3.38 in March to July inclusive, $3.68 in August and September, $3.30 in October, $3.31 in November and $3.50 in December; yearly average $3.33, and for January and February of this year, $3.50.

Prices on domestic orders for high grade rock (78 per cent.) averaged $2.78 in January and $3.13 in December, or $2.97 per long ton for the year, f. o. b. Mt. Pleasant. During January and February of this year prices were $3.00 to $3.25.

Domestic rock (75 per cent. bone phosphate) averaged $2.63 in January, and $2.88 in December, or $2.75 for the year; and for the 70.72 per cent. grade, $2.13 in May to July, $2.29 in September and $2.25 in December, or $2.21 for the year. The prices for January and February of this year upon these grades were $2.75 to $3.00 and $2.25 to $2.50 respectively; all f. o. b. Mt. Pleasant.

In South Carolina production was curtailed owing to heavy stocks in the early part of the year and small demand. Coastwise shipments and exports decreased over last year. The average prices f. o. b. Ashley river, for dried rock were $4.50 in January and February, $3.25 in March to July, making $3.65 for the year. Of the crude rock, comparatively little has been sold out of the State, the average price for the year being $3.36. During January and February of this year land rock was quoted at $3.25 and river rock at $2.75 to $3.25.

The mine prices for 1901, at all the principal points of production, were materially lower than during 1900, to a degree which is not fully reflected by the New York quotations.

Raw Materials of Acid Manufacture.

Brimstone: High prices and increased consumption of pyrites by acid-makers have reduced the imports of brimstone about 7,000 tons. The total imports into the United States for 1901, as given by the Engineering and Mining Journal, were about 160,000 tons, chiefly in best unmixed seconds; and these were consumed largely by paper mills. Prices were maintained by the trust in Sicily nearly all through the year and would have continued to rise had not the Anglo-Sicilian Co. been compelled to make concessions. As compared with those of 1900, New York prices show an increase of 77 cents a ton for spot and 82 cents for shipments. Best unmixed thirds sold in New York at $2 to $3 below best unmixed seconds. The average New York price for 1901 for best unmixed "seconds" "spot" was $22.95.

Pyrites: The demand has been good and deliveries on contract large at good prices. Domestic production has increased and imports during the year 1901 were 17 per cent. above those for 1900. The U. S. Bureau of Statistics shows imports for the year ending June 30, 1901, of 339,217 tons, valued at $1,166,686, or $3.44 per ton. For the year ending June 30, 1900, the imports were 334,131 tons, at $3.61, in both cases most of the imports being from Spain.

The Engineering and Mining Journal estimates the imports into this country for 1901 as 389,000 tons, chiefly from Spain. Low freight rates favored these large imports. The same journal summarizes prices as follows: Spanish pyrites (Huelva, 46-51 per cent. sulfur) were sold at 12 to 14 cents per unit ($5.52 to $7.14 per ton) ex ship Atlantic ports. Domestic pyrites, 42-44 per cent. sulfur, f. o. b. Mineral City, Va., $4.90 per ton for "lump" ore and 10 cents per unit ($4.70 per ton) for fines." Massachusetts, f. o. b. Charlemont, $5.00 to $5.50 for "lump" and $4.75 to $500 for "fines." The raw materials for acid manufacture were, therefore, only a little higher than during the preceding year, though the fall of 1901 witnessed an increase.

Concerning sulfuric acid, the same authority states that the General Chemical Co. has kept prices at a satisfactory level. As the year advanced, prices were raised to meet the higher cost of raw material. In New York, prices were for 66 per cent. acid, $1.10—$1.30 per 100 lbs.; for 60 per cent. acid, 90 cents to $1.10 per 100 lbs., and for 50 per cent. acid in bulk $12.00 to $16.00 per ton.

During the fall of 1901, therefore, rock prices were considerably lower, acid prices slightly higher than in 1900. Valuation schedules must be based, however, upon the actual wholesale prices of the acid phosphates, rather than upon those of the raw materials from which they are made. New York wholesale quotations for acid phosphate, per unit of available phosphoric acid, were, according to the Oil, Paint and Drug Reporter, during 1900-1, 64.2 cts.; during 1901-2, 62.5 cts. According to the Engineering and Mining Journal, acid phosphate was offered, early this year, for 57.5 to 60.0 cents per unit; the retail selling prices in this State decreased from the spring to the fall of last year nearly 7 cents per unit.

Potash Salts: The reports of the U. S. Bureau of Statistics show the following entries for consumption during the fiscal years 1900 and 1901:

	1900	1901.
Muriate (pounds),	113,032,418	138,561,091
Kieserit, kainit, etc. (tons),	133,244	187,470

The German Potash Syndicate regulates the prices on potash salts and has held the 1902 schedule at the same level as that of 1901.

On the basis of large lots sold through brokers for cash and delivered at Boston, New York or Philadelphia, the schedules announced by the Syndicate are as follows.

Salt.	After March 1, 1900.	February, 1901.	After March 1, 1901.
Muriate:			
(80 to 85 per cent., 80 per cent. basis), cwt.,	$1 80	$1 80	$1 83
(95 per cent., 80 per cent. basis), cwt.,	....	1 83	1 86
Sulfate:			
(90 per cent., 90 per cent. basis), cwt.,	2.25	2 08	2 11
(96 per cent., 90 per cent. basis). cwt.,	....	2 11	2 14
Double manure salt (48 to 50 per cent., 48 per cent. basis), cwt.,	1 04	1 09	1 12
Kainit (12.4 per cent. actual potash) per ton at port of shipment,	8 80	8 80	....
Sylvinite (per unit potassium sulfate),	....	38-39	....
Manure salt (20 per cent. potash), per unit potash,	....	62-64	....

This trade is so managed that, before March 1, nearly all wholesale deliveries of the year are contracted for.

Composition of Raw Materials.

In order to form a correct idea of the cost per pound of the fertilizing constituents of these materials, it is needful to determine their composition; or, in other words, the quantities of valuable constituents each contains. The following table shows the composition of the raw materials used in the manufacture of fertilizers. Very few analyses for these materials, with the exception of ground bone and dissolved rock, have been made in Pennsylvania. The figures in the following table include the averages of the results of analyses made in Connecticut, Massachusetts, New Jersey and Pennsylvania during the past year, except in the case of ground bone and dissolved rock phosphates, where Pennsylvania results alone are included.

Composition of Non-Acidulated Fertilizer Ingredients (Per Cent).

	Number of samples analyzed.	Nitrogen.	Potash.	Total phosphoric acid.
Sulfate of ammonia,	1	19.81	....	....
Nitrate of soda,	19	15.68	....	....
Dried blood,	6	11.43	....	....
Ground bone,	77	3.11	....	22.74
Tankage,	11	5.54	....	16.47
Ground fish,	15	7.61	....	6.40
Cotton seed meal,	46	7.24	1.90	3.15
Castor pomace,	5	5.01	.92	2.08
Sulfate of potash, high grade,	8	....	49.83	....
Muriate of potash,	30	....	50.43	....
Kainit,	4	....	13.44	....
Double sulfate of potash and magnesia,	8	....	26.47	....

Composition of Acidulated Fertilizer Ingredients (Per Cent).

	Number of samples analyzed.	Total phosphoric acid.	Soluble phosphoric acid.	Reverted phosphoric acid.	Insoluble phosphoric acid.
Dissolved bone-black,	5	16.75	12.53	2.81	1.41
Dissolved bone,*	6	17.55	2.03	6.70	8.82
Dissolved rock phosphate,	98	16.05	9.86	4.71	1.48

*Also contains 2.40 per cent. nitrogen.

The above figures, considering only those cases where a considerable number of analyses are available, would indicate that there has been no great change in the composition of the raw materials used in fertilizer manufacture.

Cost per Pound of Fertilizer Constituents.

From the foregoing data showing the cost per ton, hundredweight, or other unit of measure, of the several raw materials, and the quantities of valuable constituents the average materials now on the market contain, the wholesale cost per pound of the valuable constituents can be readily estimated. In the case of ammoniates, the quotations are "per unit of ammonia" in many cases. The term "unit" is equivalent to "per cent.;" in goods sold by the ton of 2,000 lbs., the unit is equal to 20 lbs.; and 20 lbs. of ammonia contain 16.47 lbs. of nitrogen.

In the case of refuse bone-black, unacidulated, the mean, 28.25 per cent. of phosphoric acid, is assumed to represent the average material on the market.

Phosphate rock is sold by the ton of 2,240 lbs.; this material is sold on the basis of the bone-phosphate of lime it contains, with drawbacks for injurious constituents. Since the bone phosphate of lime contains 45.8 per cent. of phosphoric acid, each per cent. of bone phosphate in a long ton of phosphate rock is equivalent to 22.4 lbs. and contains 10.26 lbs. of phosphoric acid.

In the wholesale trade, it is customary to sell dried blood, azotine, horn and hoof meals, and concentrated tankage solely on the basis of ammonia, to the entire disregard of the phosphoric acid contained.

Likewise, the insoluble phosphoric acid in dissolved rock is omitted from consideration, and contracts are based solely upon the "available" phosphoric acid; that is, the sum of the "soluble" and "reverted" or "citrate soluble" phosphoric acid; nor in rock phosphates is any claim made for the small quantities of nitrogen and potash they always contain, nor in dissolved bone for the potash present.

Under these conditions, the wholesale cost per pound in New York of the valuable constituents of such materials as furnish but a single fertilizing element, these materials being assumed to be in the state of preparation and in the package in which the manufacturer purchased them, are given in the following table; also, a figure representing a fair retail price at the factory, the materials having undergone no change in treatment or packing, and the allowance for expense and profit in retailing being 20 per cent.

Wholesale Cost per Pound of Fertilizer Constituents (New York).

I. Ingredients Supplying One Constituent.

Material.	Constituent Valued.	Wholesale price. Cents.	Wholesale price plus 20 per cent.
Sulfate of ammonia,	Nitrogen,	14.30	17.16
Nitrate of soda,	Nitrogen,	12.68	15.22
Dried blood, high grade,	Nitrogen,	13.59	16.31
Concentrated tankage,	Nitrogen,	9.86	11.83
Refuse bone-black,	Phosphoric acid total,	3.36	4.03
*Phosphate rock:			
(Peace river, 60 per cent.),	Phosphoric acid total,	.41	.49
(Tennessee, 78 per cent.),	Phosphoric acid total,	.39	.47
(South Carolina, 60 per cent.),	Phosphoric acid total,	.53	.67
Acid phosphate,	Phosphoric acid available,	3.13	3.76
Double manure salts,	Potash,	4.20	5.04
Sulfate of potash,	Potash,	4.28	5.14
Muriate of potash,	Potash,	3.56	4.27
Kainit,	Potash,	3.55	4.26

*The prices of phosphate rock are f. o. b. at the respective points of shipment, not New York, and are taken from the reports of the Engineering and Mining Journal. The prices for potash are taken from the schedule of the Syndicate and those of the remainder from the Oil, Paint and Drug Reporter.

The quotations for bone are given without specific reference to quality, so that it is impossible from these data to fairly apportion their several wholesale values to the nitrogen and phosphoric acid contained in this material. As compared with tankage, the general tendency is to assign a higher commercial rating to the phosphoric acid in bone and to the nitrogen a rating not very different from that given in tankage.

The quotations of Thos. J. White and Company show an average wholesale rate in Baltimore during September, 1901, to March, 1902, for crushed tankage to have been $2.26 per unit of ammonia and $0.10 per unit of bone phosphate of lime. This is equivalent to $2.74 per unit of nitrogen and $0.218 per unit of phosphoric acid. The average composition of the ground bone and bone meal samples analyzed last fall in Pennsylvania was: Phosphoric acid, 22.53 per cent.; nitrogen, 2.94 per cent. The prepared bone contains less fat and moisture and often less nitrogen than the ordinary "rough bone;" but these differences tend, in a manner, to neutralize each other.

Assuming for the rough bone quoted in the New York market the same composition as the bone meal sold in Pennsylvania and for the value of the nitrogen $2.74 per unit, the values per pound of the several constituents would be:

Wholesale Cost per Pound of Fertilizer Constituents, New York.

II. Bone.

Grade.	Constituent Valued.	Wholesale price.	Wholesale price plus 20 per cent.
Rough bone,	Nitrogen,	13.7	16.4
	Phosphoric acid,	2.26	2.71
Ground bone,	Nitrogen,	15.39	18.42
	Phosphoric acid,	2.54	3.04

The average ground bone and bone meal on the retail market are probably inferior in composition to the rough bone on the wholesale market, hence these figures tend to be too high. Direct estimation of the wholesale pound values of acidulated bone (animal bone) cannot be made, as there are no wholesale data available for this purpose; for this computation dependence must be placed upon the retail selling prices.

Valuations in Neighboring States.

It is desirable, from all points of view, that the schedules of valuation throughout a district in which similar market conditions prevail, should differ as little as possible. It has been our practice in the past, to conform our schedule to that adopted after very careful co-operative study of market conditions for each year, by the New England States and New Jersey, except where the peculiar conditions of our market have made the valuations diverge too largely from the actual selling prices, as in the case of ground bone and dissolved rock phosphates. The schedules for these States for 1900 and 1901 are as follows:

Trade Values Adopted by the New England States and New Jersey.

	Cents per lb.		Values of 1902 in per cent. of those of 1901.
	1901.	1902.	
Nitrogen:			
In ammonia salts,	16½	16½	100
In nitrates,	14	14	100
In dry and fine-ground fish,	16	16½	103.1
In meat, blood and mixed fertilizers,	16	16½	100
In fine-ground bone and tankage,	16	16½	100
In coarse bone and tankage,	12	12	100
Phosphoric acid:			
Water soluble,	5	5	100
Citrate soluble,	4½	4½	100
In cotton-seed meal, castor pomace and wood ashes,	4	4	100
In dry, fine-ground fish, bone and tankage,	4	4	100
In coarse fish, bone and tankage,	3	3	100
In mixed fertilizers, insoluble,	2	2	100
Potash:			
In forms free from muriate (chlorid),	5	5	100
As muriate,	4¼	4¼	100

Upon a careful consideration of the changes and tendencies of the wholesale prices of fertilizer ingredients and of the discrepancies occurring since the adoption of the 1901 schedule of valuation, it has been decided that the schedule for use during 1902 should be the same as that adopted for the use of New Jersey and New England except at two points.

For reasons fully discussed in 1897, it is needful to include in the Pennsylvania schedule of valuations, a distinct set of values for phosphoric acid derived from rock as contrasted with that derived from animal materials. Reference to the tables, given on an earlier page, showing the wholesale cost of a pound of phosphoric acid, will make it plain that when it comes from phosphate rock, it costs the fertilizer maker about one-half to three-fourths of a cent at the mines, on the Atlantic seaboard; when from refuse bone-black, delivered at New York, 3.4 cents; when from tankage, about 1.1 cents; and from bone 2.69 cents.

There is nothing to indicate that, after acidulation, the available phosphoric acid from bone is at all better for the crop than that from a good rock lime-phosphate. But so long as the consumer is persuaded that bone phosphoric acid is worth more for his crop than an equal weight of rock phosphoric acid, just so long will the manufacturer of fertilizers be able to command a higher price for those fertilizers reputed to derive their phosphoric acid from bone, and just so long will he, in turn, be obliged to pay more for it on the wholesale market. Now, in some States, the volume of rock phosphoric acid used is relatively small and the need for its separate valuation not apparent; in other States it predominates to the almost entire exclusion of bone phosphoric acid, so that no distinct valuation for the latter is required; but in Pennsylvania both occupy important positions upon the market and each requires its own set of values. Despite the slightly upward tendency of the acid phosphate market, it is thought needless to change the valuations of these constituents at this time, because the average valuations have, under the existing schedule, considerably exceeded the actual selling prices.

For similar reasons, nitrogen and phosphoric acid in ground bone are valued at lower rates in Pennsylvania than in New England. Owing to the fact that the bone valuations of the past year fell distinctly below the selling prices, a slight increase in the valuations of these goods has been made. Tankage is scheduled with bone, though costing less, because it is little sold at retail.

The schedule for 1901 as a whole is as follows:

Schedule of Values for Fertilizer Ingredients, 1902.

	Cents per pound.
Nitrogen:	
In ammonia salts,	16½
In nitrates,	14
In meat, dried blood and mixed fertilizers,	16½
In cotton-seed meal and castor-pomace,	16½
In fine ground bone and tankage,	11
In coarse bone and tankage,	9
Phosphoric acid:	
Soluble in water, in bone fertilizers,	5
Soluble in water, in rock fertilizers,	3
Soluble in ammonium citrate, in bone fertilizers,	4½
Soluble in ammonium citrate in rock fertilizers,	2½
Insoluble in ammonium citrate, in bone fertilizers,	2
Insoluble in ammonium citrate, in rock,	1½
In fine bone, tankage and fish,	3
In coarse bone and tankage,	2½
In cotton-seed meal, castor pomace and wood ashes,	4
Potash:	
In high-grade sulfate or in forms free from muriate,	5
As muriate,	4¼

Potash in excess of that equivalent to the chlorin present, will be valued as sulfate, and the remainder as muriate.

Nitrogen in mixed fertilizers will be valued as derived from the best sources of organic nitrogen, unless clear evidence to the contrary is obtained.

Phosphoric acid in mixed fertilizers is valued at bone phosphoric acid prices, unless clearly found to be derived from rock phosphate.

Bone is sifted into two grades of fineness: Fine, less than 1-50 inch in diameter; coarse, over 1-50 inch in diameter.

The result obtained by the use of this schedule does not cover the items of mixing, bagging, freight and agents' commission. To cover these, allowances are made as follows:

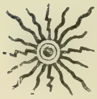
For freight, an allowance of $2.00 per ton on all fertilizers.

For bagging, an allowance of $1.00 per ton on all fertilizers, except when sold in original packages.

For mixing, an allowance of $1.00 per ton on complete fertilizers and rock-and-potash goods.

For agents' commission, an allowance of 20 per cent. is added to the cash values of the goods ready for shipment.

The mean quotation on freight from New Yoak, Philadelphia and Baltimore to Harrisburg, in January, 1897, was $1.68 per ton, in lots of twelve tons or over; in May, 1899, quotations by the Pennsylvania Railroad were: From New York, $2.40; from Philadelphia, $1.70; and from Baltimore, $1.55; mean rate from the three points, $1.88.



ANALYSES OF SPRING SAMPLES.

Tabulated Analyses of Commercial Fertilizers

FROM

SAMPLES SELECTED BY SPECIAL AGENTS

OF THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

Analyses by DR. WILLIAM FREAR, Chemist of the Department, and of the State College Experiment Station, State College, Pa.

SAMPLES SELECTED FROM JAN. 1, 1902 TO AUG. 1, 1902.

FERTILIZER ANALYSES, JANUARY 1, TO AUGUST 1, 1902.

Since January 1, 1902, there have been received from authorized sampling agents, eight hundred and thirty-eight (838) fertilizer samples, of which four hundred and fifty (450) were subjected to analysis, the remainder being rejected either because they represented brands analyzed last season, or because they were regarded as not certainly representative of the brand whose name they bore. When two or more samples representing the same brand were received, equal portions from the several samples were united and the composite sample was subjected to analysis.

The samples group themselves as follows: 289 complete fertilizers, furnishing phosphoric acid, potash and nitrogen; 2 dissolved bones, furnishing phosphoric acid and nitrogen; 66 rock-and-potash fertilizers, furnishing phosphoric acid and potash; 59 acidulated rock phosphates, furnishing phosphoric acid only; 29 ground bones, furnishing phosphoric acid and nitrogen; 5 miscellaneous fertilizers, which group includes potash salts, nitrate of soda and other substances not properly classified under the foregoing heads.

The determinations to which a complete fertilizer is subjected are as follows: (1) Moisture, useful for the comparison of analyses, for indication of dry condition and fitness for drilling, and also of the conditions under which the fertilizer was kept in the warehouse. (2) Phosphoric acid—total, that portion soluble in water, and, of the residue, that portion not soluble in warm ammonium citrate solution (a solution supposed to represent the action of plant roots upon the fertilizer), which is assumed to have little immediate food value. By difference, it is easy to compute the so-called "reverted" acid, which is the portion insoluble in water but soluble in the citrate. The sum of the soluble and reverted is commonly called the "available" phosphoric acid. (3) Potash soluble in water,—most of that present in green sand marl and crushed minerals, and even some of that present in vegetable materials such as cotton-seed meal, not being included because insoluble in water even after long boiling. (4) Nitrogen—this element is determined by a method which simply accounts for all present, without distinguishing between the quantities present in the several forms of ammonium salts, nitrates or organic matter. (5) Chlorin; this determination is made to afford a basis for estimating the proportion of the potash that is present as chlorid or muriate, the cheaper source. The computation is made on the assumption that the chlorin present, unless in excess, has been introduced in the form of muriate of potash; but doubtless there are occasional exceptions to this rule. One part of chlorin combines with 1.326 parts of potash to form the pure muriate; knowing the chlorin, it is, therefore, easy to compute the potash equivalent thereto. (7) In the case of ground bone, the state of sub-division is determined by sifting through accurately made sieves; the cost of preparation and especially the promptness of action of bone in the soil depends very largely on the fineness of its particles, the finer being much more quickly useful to the plant.

The law having required the manufacturer to guarantee the amount of certain valuable ingredients present in any brand he may put upon the market, chemical analysis is employed to verify the guaranties stamped upon the fertilizer sacks. It has, therefore, been deemed desirable in this report to enter the guaranty filed by the manufacturer in the office of the Secretary of Agriculture, in such connection with the analytical results that the two may be compared. An unfortunate practice has grown up among manufacturers of so wording the guaranty that it seems to declare the presence in the goods of an amount of a valuable constituent ranging from a certain minimum to a much higher maximum; thus, "Potash, 2 to 4 per cent." is a guaranty not infrequently given. In reality, the sole guaranty is for 2 per cent. The guaranteed amounts given for each brand in the following tables, are copied from the guaranties filed by the maker of the goods with the Secretary of Agriculture, the lowest figure given for any constituent being considered to be the amount guaranteed. For compactness and because no essentially important fact is suppressed thereby, the guaranties for soluble and reverted phosphoric acid have not been given separately, but are combined into a single guaranty for available phosphoric acid; in cases where the maker's guaranty does not specifically mention available phosphoric acid, the sum of the lowest figures given by him for soluble and reverted phosphoric acid is used. The law of 1879 allowed the maker to express his guaranty for nitrogen either in terms of that element or in terms of the ammonia equivalent thereto; since ammonia is composed of three parts of hydrogen and fourteen parts of nitrogen, it is a very simple matter to calculate the amount of one, when the amount of the other is given; the amount of nitrogen multiplied by 1.214 will give the corresponding amount of ammonia, and the amount of ammonia multiplied by 0.824 will give the corresponding amount of nitrogen. In these tables, the expression is in terms of nitrogen.

The law of 1901 abolishes this alternative and requires that the guaranty shall be given in terms of nitrogen. Many manufacturers after complying with the terms of the law, insert additional items in their guaranties, often with the result of misleading or confusing the buyer; the latter will do well to give heed to those items only that are given as the law requires and that are presented in these tables.

A summary of the analyses made this season may be presented as follows, excepting the miscellaneous class:

Summary of Analyses made this Season.

	Complete fertilizers.	Dissolved bone.	Rock and potash.	Dissolved rock.	Ground bone.
Number of analyses,	289	2	66	59	29
Moisture, per cent.,	8.93	7.83	10.90	9.06	5.89
Phosphoric acid:					
Total, per cent.,	10.77	12.96	11.89	15.88	22.22
Soluble, per cent.,	4.85	2.65	4.95	9.43	....
Reverted, per cent.,	3.41	4.45	5.37	4.65	....
Insoluble, per cent.,	2.51	5.86	1.57	1.80	....
Potash, per cent.,	3.97	....	3.09	....	....
Nitrogen, per cent.,	1.62	1.37	....	....	3.43
Mechanical analysis of bone:					
Fine,	....	....	....	....	69
Coarse,	....	....	....	....	31
Commercial valuation,	25.33	17.35	15.05	13.44	26.87
Average selling price,	24.10	16.50	16.45	13.73	28.52
Commercial value of samples whose selling price is ascertained,	25.33	17.35	15.05	13.49	26.80

Two tendencies appear upon a comparison between these data and the corresponding figures for the spring of 1901: A diminution of soluble phosphoric acid and a general increase in the percentages of reverted and insoluble phosphoric acid, while the total phosphoric acid is slightly increased; this tendency appeared in a great many brands. The use for acidulation of rock phosphates which, though richer in phosphoric acid, also contain more iron and alumina than heretofore, would account for this tendency, since the phosphates in acidulated goods from such rock tend to revert to insoluble forms. The second tendency is toward the greater use of potash, which appears in both complete fertilizers and rock-and-potash goods. The dissolved bones were very inferior.

The cases of departure of goods from their guaranteed composition observed this season, including only those cases in which it amounted to two-tenths per cent. or more, were as follows:

Summary of Instances of Deficiency from Guaranty.

	Complete fertilizers.	Dissolved bone.	Rock and potash.	Dissolved rock.	Ground bone.
Deficient in four constituents,	1				
Deficient in three constituents,	6				
Deficient in two constituents,	25		2	2	
Deficient in one constituent,	83	2	18	7	5
Total samples in which deficiency occurred,	115	2	20	9	5

The cases of deficiency noted during the past seven seasons in the goods as compared with their guaranties, expressed in percentage of the total number of goods of each class analyzed, are as follows:

Percentages of Deficiency, 1899—1902.

	Spring, 1899.	Fall, 1899.	Spring, 1900.	Fall, 1900.	Spring, 1901.	Fall, 1901.	Spring, 1902.
Complete fertilizers,	38.4	33.7	42.0	40.8	31.6	34.6	40.00
Dissolved bone,	50.0	14.3	*50.0	*50.0	†	40.0	*100.00
Rock and potash,	19.1	34.2	29.2	33.3	31.7	26.2	30.3
Dissolved rock,	13.8	14.5	5.4	19.4	22.5	8.2	15.2
Ground bone,	18.4	25.3	36.7	11.8	34.1	18.2	17.2
All classes except miscellaneous,	30.9	29.2	35.2	34.3	30.8	27.6	34.2

*Only two samples analyzed.
†Only one sample analyzed.

Marked variations in the general percentages of deficiency occur from year to year. During the past season, they have been somewhat more numerous than usual. In most samples which are found below guaranty at one point, there is an excess at some other point, indicating that the cause of departure from the composition guaranteed lay not in the failure of the manufacturer to use the requisite components, but in his failure to secure a uniform mixture.

Considering all cases of complete fertilizers in which guaranties were strictly comparable with stated analytical results and sufficiently complete for the purpose: Of the one hundred and fifteen samples in which there was deficiency at some point, there were only seventeen in which there was not distinct excess above guaranty at some other point, though sometimes such excess was not sufficient to counter-balance the deficiency. Naturally, the tendency is toward excess of the cheaper constituent, phosphoric acid, and deficiency of potash or nitrogen, as appears below.

Two-thirds of the brands were up to or above guaranty at all points. The true average condition of the market for complete fertilizers will be more fairly exhibited by a comparison of the average composition of all samples for which guaranties are recorded with the average of the corresponding guaranties; they are as follows:

Average Composition and Guaranty Compared.

	Average composition. Per cent.	Average guaranty. Per cent.
Fall, 1901.		
Phosphoric acid:		
Total,	11.51	9.82
Available,	10.60	8.06
Potash,	2.77	2.66
Nitrogen,	1.39	1.39
Spring, 1902.		
Phosphoric acid:		
Total,	10.80	9.29
Available,	8.25	7.82
Potash,	3.90	3.66
Nitrogen,	1.62	1.58

It is of interest to note how closely the system of valuations, based upon the wholesale prices of raw materials in the principal markets during the most important buying season and upon certain average allowances for expense and profit on the part of the mixer and jobber, coincides with the retail prices later ascertained. A comparison for several seasons past is given below:

Comparison of Selling Price and Valuation, 1899—1902.

	Selling price.	Valuation.	Excess of valuation over selling price.
Complete fertilizers:			
1899, Spring,	$23.60	$24.70	$1.10
Fall,	22.98	23.42	.44
1900, Spring,	25.38	24.61	—.77
Fall,	23.22	23.84	.62
1901, Spring,	23.92	24.76	.84
Fall,	22.28	23.75	1.47
1902, Spring,	24.10	25.33	1.23
Dissolved bone:			
1899, Spring,	21.75	21.81	.06
Fall,	19.00	21.12	2.12
1900, Spring,	26.00	30.87	4.87
Fall,	23.50	22.74	—.76
1901, Spring,	28.00	29.00	1.00
Fall,	23.91	23.36	—.55
1902, Spring,	16.50	17.35	.85
Rock and potash:			
1899, Spring,	16.83	15.16	—1.67
Fall,	17.28	14.53	—2.75
1900, Spring,	17.35	14.71	—2.64
Fall,	18.11	14.63	—3.48
1901, Spring,	16.20	14.60	—1.60
Fall,	16.09	14.23	—1.86
1902, Spring,	16.45	15.05	—1.40
Dissolved rock:			
1899, Spring,	13.36	14.03	.67
Fall,	12.64	13.13	.49
1900, Spring,	13.57	13.48	—.09
Fall,	13.96	13.11	—.85
1901, Spring,	13.90	13.51	—.39
Fall,	13.18	13.82	.64
1902, Spring,	13.73	13.49	—.24
Ground bone:			
1899, Spring,	26.67	28.11	1.44
Fall,	24.98	27.23	2.25
1900, Spring,	28.42	25.91	—2.51
Fall,	28.73	26.87	—1.86
1901, Spring,	27.59	28.71	1.12
Fall,	25.94	27.69	1.75
1902, Spring,	28.52	26.80	—1.72

The schedule of valuation adopted for use this year has given valuations agreeing well with the market prices of the spring trade; the only exceptions is in the case of ground bone in which the average valuation appears about as far below the average selling price, as it was above the latter under the schedule of 1901. The true relation can be ascertained only by taking into account the average freight to points of sale from which samples were taken this year. Rock-and-potash selling prices are always high in comparison with those of complete fertilizers, but the disparity seems to be diminishing.

The results of the United States Census relative to manufactures being now available, some facts of especial interest respecting the fertilizer trade appear. Prior to the consideration of these data, a comparison of the average composition of the complete fertilizers analyzed by this Control in 1890 and 1900 is given;

	1890. Per cent.	1900. Per cent.
Moisture,	12.20	9.11
Phosphoric acid:		
Total,	12.47	10.80
Soluble,	6.36	4.87
Reverted,	2.98	3.62
Insoluble,	3.13	2.31
Potash,	3.04	3.43
Nitrogen,	1.86	1.67
Valuation,	$30.06	$24.35
Selling price,	28.64	24.68

That is to say, one dollar bought in complete fertilizers at the two periods the following quantities of the valuable constituents:

	1890. Pounds.	1900. Pounds.
Phosphoric acid,	8.71	8.75
Potash,	2.12	2.78
Nitrogen,	1.29	1.35

That is, for the same money, the retail purchaser secured in 1900 about the same amount of phosphoric acid, thirty-one per cent. more potash and nearly five per cent. more nitrogen than in 1890.

A brief summary of the Census statistics for 1890 and 1900 showing the values involved in the fertilizer manufacture of the United States is as follows:

	1890.	1900.
Number of establishments,	390	422
Capital,	$40,594,168	$60,685,763
Wage earners employed,	9,026	11,581
Wages paid (total),	$3,417,870	$4,185,289
Miscellaneous expenses,	$2,790,012	$3,734,285
Cost of materials used,	$25,113,874	$28,958,473
Value of products,	$39,180,844	$44,657,385

From these the following comparative statement for the two periods is derived:

	1890.	1900.
Average wages paid each wage earner,	$378.67	$361.39
Capital invested for each $1 of raw material manufactured,	1.62	2.10
Cost of manufacturing $1 of raw material into finished products:		
Cost of raw material,	$1.00	$1.00
Interest on capital corresponding,	.081	.105
Wages,	.136	.145
Miscellaneous expenses,	.111	.128
Total cost,	$1.328	$1.378
Estimated value of products,	$1.560	$1.543

In general, that is, the stated cost of manufacture has increased during the decade, about 4 per cent., while the estimated value of the product has fallen between one and two per cent., the net profits being 17.5 per cent. of the cost of production in 1890 and 11.9 per cent. in 1900.

This decrease in net profit is due chiefly to increased cost of production. A little more than one-fourth of the increase occurs in the item of miscellaneous expenses, including insurance, interest, taxes, etc.; almost an equal fraction of the increase is due to the smaller earning efficiency of $1 spent in wages (including salaries), despite the fact that the average wages paid to each earner is 7.5 per cent. less than in 1890. One-half of the whole increase is attributable, however, to the interest item on the stated capitalization, which has increased almost thirty per cent. for each dollar's worth of raw material used.

This stated increase is distributed as follows, in terms of the items for 1890:

	Per cent.
Land,	28.2
Buildings,	54.3
Machinery and implements,	56.4
Total plant,	49.1
Cash and sundries,	49.7

This increase of stated capitalization, proportionally so much greater than the increase in the cost of raw materials and the value of finished products, naturally raises a question as to how much of the stated capital represents money invested. This is at present a question for stock buyers. It is sufficient to the consumer to know that, as compared with 1890, he was in 1900 able to purchase more fertilizer for one dollar; and that whereas in 1890 he was obliged to pay at the factory 56 cents advance upon every dollar's worth of raw material used by the manufacturer, in 1900 the advance was only 54.3 cents.

The foregoing advances are not comparable with those allowed in the schedule of valuations to the mixer, for the cost of acidulation is excluded in the latter case, having been already included in the wholesale value of the acid rock and dissolved bone.

The analytical work has been performed by the following assistant chemists: Nitrogen, Mr. M. S. McDowell; soluble and insoluble phosphoric acid, Mr. C. W. Norris; potash and chlorin, Mr. M. H. Pingree; moisture and total phosphoric acid, Mr. N. W. Buckhout. The listing and preparation of samples were in charge of Mr. McDowell; the computation and care of records in charge of Misses M. Garner and E. F. Jones.

Respectfully submitted,

WM. FREAR.

August 5, 1902.

TABULATED ANALYSES.

COMPLET

Furnishing Phosphoric Ac

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	
	Allegheny City Fert. Works, Allegheny, Pa.		
799	Potato Manure,	J. E. McFadden, Cyrus,	
805	Pure Potato Manure,	Lewis Patterson, Slippery Rock,	
642	Raw Bone Phosphate,	L. & F. Hoburg, Sharpsburg,	
800		J. E. McFadden, Cyrus,	
	The American Agri. Chem. Co., New York.		
	Bradley Branch, New York.		
646	†Bradley's Bean and Potato Phosphate,	S. J. Saint, Sharpsburg,	10
469		Daniel Hurley, North Rome,	
330		J. M. Fisk, Bills,	
715		Punxsutawney Hdw. Co., Punxsut'y,	
786		J. B. Miller, Wesley,	
718	†Bradley's Dissolved Bone and Potash,	Punxsutawney Hdw. Co., Punxsu'ty,	9
644		S. J. Saint, Sharpsburg,	
468		Daniel Hurley, North Rome,	
785		J. B. Miller, Wesley,	
828		J. H. Sheffer, Knox,	
717	†Bradley's Niagara Phosphate,	Punxsutawney Hdw. Co., Punxsu'ty,	7
647		S. J. Saint, Sharpsburg,	
632		C. B. Neiderheiser, Donegal,	
803		E. H. Adams, Wick,	
827		J. H. Sheffer, Knox,	
783	†Bradley's Sea Fowl Guano,	Trax & James, Oil City,	9
645		S. J. Saint, Sharpsburg,	
802		E. H. Adams, Wick,	
826		—— ——, Knox,	
	Canton Chemical Branch, Baltimore, Md.		
242	Canton Chemical Ammoniated Bone,	Jones Paxton, Hatboro,	9.
335	Canton Chemical, Baker's Standard H. G. Guano,	Jos. D. Miller, Rockwood,	8.

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†Composite sample.

ERTILIZERS.

tash and Nitrogen.

Phosphoric Acid in 100 Pounds.						Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2 000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
Reverted.	Insoluble.	Total.		Available.		Present as muriate.	Present as sulphate.	Total.		Found.	Guaranteed.			
		Found.	Guaranteed.	Found.	Guaranteed.			Found.	Guaranteed.					
1.69	4.36	**10.63**	10.00	***6.27**	8.00	3.60	2.50	**6.10**	6.00	***2.17**	2.47	$29.04	$29.00	799
2.21	5.25	**10.92**	10.00	***5.67**	8.00	4.40	2.35	**6.75**	6.00	**2.66**	2.47	31.24	25.00	805
2.65	4.09	**11.69**	10.00	***7.60**	9.00	4.41	......	**4.41**	4.00	***1.53**	1.65	25.81	26.00	642
													25.00	800
3.13	1.86	**11.00**	9.00	**9.14**	8.00	4.31	......	**4.31**	4.00	**1.13**	.82	24.85	25.00	646
													24.00	469
													....	330
													30.00	715
													25.00	786
3.10	2.04	**11.14**	9.00	**9.10**	8.00	2.38	.....	**2.38**	2.00	**1.34**	1.03	23.73	24.00	718
													23.00	644
													24.50	468
													24.00	785
													25.00	828
3.54	2.17	**10.76**	8.00	**8.59**	7.00	1.27	......	**1.27**	1.00	**1.09**	.82	20.96	23.00	717
													22.00	647
													20.00	632
													22.00	803
													23.00	827
2.75	3.47	**12.37**	9.00	**8.90**	8.00	2.14	......	**2.14**	1.50	**2.20**	2.06	27.32	25.00	783
													25.00	645
													24.00	802
													30.00	826
3.66	2.60	**10.15**	9.00	***7.55**	8.00	1.88	......	**1.88**	2.00	***1.15**	1.24	20.78	21.00	242
3.48	1.96	**10.36**	9.00	**8.40**	8.00	3.23	......	**3.23**	3.00	**2.10**	2.06	26 62	25.00	335

Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
356	†Canton Chemical, Baker's Special Wheat, Corn and Grass Mixture,	T. J. Jacobs, Somerfield,	10.02
334		Jas. D. Mliler, Rockwood,	
498		A. D. Trexler, Trexler,	
361	†Canton Chemical, C. C. C. Special Compound,	King Bros., Uniontown,	8.68
74		D. B. Meyers, Gardners Sta.,	
374		S. F. Miller, Mechanicsburg,	
694		H. L. Orr, Tyrone,	
610	†Canton Chemical, Eagle Phosphate,	J. A. Romberger, Elizabethville,	7.13
241		Jones & Paxton, Hatboro,	
666		Styles, Miller & Co., Martinsburg,	
684		H. F. Gump, Everett,	
537	Canton Chemical, Harrow Brand Crop Grower,	J. W. Hostetter, Walnut,	7.90
371	†Canton Chemical, Potato Manure, 1½—6—5,	S. F. Miller, Mechanicsburg,	8.45
360		King Bros., Uniontown,	
357		T. J. Jacobs, Somerfield,	
126		J. H. Wingert, Lewisburg,	
499		A. D. Trexler, Trexler,	
671		H. L. Stultz, Duncansville,	
695		H. L. Orr, Tyrone,	
743		W. S. Weaver, Easton,	
240	Canton Chemical, Resurgam Guano,	Jones & Paxson, Hatboro,	10.00
	Clark's Cove Branch, New York.		
153	†Clark's Cove King Philip Alkaline Guano,	Peter Haus, New Columbia,	11.73
52		E. J. Bushey, Dillsburg, R. R. track,	
546		Fowler Ellis, Franklindale,	
152	Clark's Cove Potato and Hop Grower,	Thomas Grover, New Columbia,	9.86
538		P. M. Hunsinger, Dushore,	
	Crocker Branch, Buffalo, N. Y.		
190	Crocker's Ammoniated Bone Superphosphate,	John A. Loose, Berne,	6.49
835	Crocker's Complete New Rival,	H. B. Mitchell & Co., Emlenton,	7.87

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†Composite sample.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
Soluble in water.	Reverted.	Insoluble.	Total.		Available.		Present as muriate.	Present as sulphate.	Total.		Found.	Guaranteed.			
			Found.	Guaranteed.	Found.	Guaranteed.			Found.	Guaranteed.					
7.76	2.58	1.38	**11.72**	10.00	**10.34**	9.00	2.35	......	**2.35**	2.00	**1.15**	.82	$24.12	$22.00	356
														21.00	334
														22.00	498
6.01	2.65	2.05	**10.71**	9.00	**8.66**	8.00	6.23	......	**6.23**	6.00	**2.17**	2.06	30.34	32.00	361
														25.00	74
														30.00	374
														33.00	694
3.36	4.86	1.75	**9.97**	8.00	**8.22**	7.00	1.31	......	**1.31**	1.00	**.99**	.82	19.80	17.00	610
														19.00	241
														18.75	666
														21.00	684
5.28	3.89	1.11	**10.28**	9.00	**9.17**	8.00	1.36	......	**1.36**	1.00	**.93**	.82	20.65	......	537
3.34	3.55	1.54	**8.43**	7.00	**6.89**	6.00	5.10	......	**5.10**	5.00	**1.43**	1.24	23.96	24.00	371
														28.00	360
														24.00	357
														20.00	126
														25.00	499
														25.00	671
														28.00	695
														25.00	743
4.72	3.61	2.08	**10.41**	9.00	**8.33**	8.00	4.44	......	**4.44**	4.00	**1.20**	.82	24.22	22.00	240
5.37	3.59	1.42	**10.38**	9.00	**8.96**	8.00	2.52	......	**2.52**	2.00	**1.40**	1.03	23.54	20.00	153
														18.50	52
														20.00	546
3.02	3.90	1.83	**8.75**	7.00	**6.92**	6.00	4.98	......	***4.98**	5.00	**1.51**	1.24	24.14	24.00	152
														30.00	538
5.22	4.22	1.81	**11.25**	11.00	**9.44**	9.00	2.24	......	**2.24**	2.00	***2.42**	2.47	27.90	24.00	190
5.69	4.19	2.34	**12.22**	11.00	**9.88**	9.00	2.18	......	**2.18**	2.00	**1.45**	1.24	24.87	23.00	835

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
373	†Crocker's General Crop Fertilizer,	S. F. Miller, Mechanicsburg,	9.1
191		John A. Loose, Berne,	
752		Jos. Froelich, Mountville,	
834	Crocker's General Crop Grower,	H. B. Mitchell & Co., Emlenton,	7.9
372	Crocker's Universal Grain Grower,	S. F. Miller, Mechanicsburg,	12.6
	Detrick Branch, Baltimore, Md		
519	Detrick's Bone Phosphate for Potatoes and Tobacco,	Jas. McCully, Mifflintown,	12.2
654	†Detrick's Corn and Oats Fertilizer,	Wm. H. Heckert, Bakerstown,	8.5
724		John Bodenshatz, Wilmore,	
216	†Detrick's K. K. K. Kangaroo Komplete Kompound,	W. T. Hoover, Pt. Matilda,	9.4
14		Passmore & Gillespie, Sylmar,	
725		John Bodenshatz, Wilmore,	
432	Detrick's Quickstep Bone Phosphate for Potatoes and Tobacco,	J. S. Fobst, Emaus,	10.0
	Great Eastern Branch, Rutland, Vt.		
604	†G. E. English Wheat Grower, 1x8x2,	W. E. Smith, Laurelton,	9.7
820		Neely Bros., Alum Rock,	
475	†G. E. General,	O. Tiffany, Dushore Sta.,	10.2
327		Jos. M. Miller, Bills,	
315		N. G. Gramling, Elton,	
251		William Jones, Kelton,	
487		Jos. Yorkon, Dushore,	
818		J. B. Atwell, Big Bend,	
819		Neeley Bros., Alum Rock,	
329	G. E. Good Grower Potato Phosphate,	J. M. Fisk, Geigers Sta.,	9.8
486	G. E. Northern Corn Grower,	Jos. Yorkon, Dushore,	9.7
314	†G. E. Northern Corn Special,	N. G. Gramling, Elton,	8.7
497		A. S. Lutz, Wanamaker,	
488	†G. E. Wheat Special,	Jos. Yorkon, Dushore,	8.8
821		McEwen & Curll, Sligo,	
485	†G. E. Vegetable and Tobacco Fertilizer,	Jos. Yorkon, Dushore,	9.5
545		Vine Avery, Monroeton,	

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
5.05	3.71	1.10	**9.86**	8.00	**8.76**	7.00	1.40	......	**1.40**	1.00	**.97**	.82	$20.18	$18.50	373
														18.00	191
														....	752
6.27	2.27	1.27	**9.81**	8.00	**8.54**	7.00	1.63	......	**1.63**	1.00	**.86**	.82	20.05	20.00	834
7.63	2.21	.90	**10.74**	9.00	**9.84**	8.00	2.40	......	**2.40**	2.00	**1.13**	.82	23.40	20.00	372
7.57	1.96	.48	**10.01**	9.00	**9.53**	8.00	4.22	......	**4.22**	4.00	***2.40**	2.47	29.60	26.00	519
6.33	3.39	1.43	**11.15**	10.00	**9.72**	9.00	2.92	......	***2.92**	3.00	**.89**	.82	22.89	21.00	654
														24.00	724
3.48	4.41	2.68	**10.57**	9.00	***7.89**	8.00	4.07	......	**4.07**	3.00	**2.02**	1.65	26.55	25.00	216
														24.00	14
														26.00	725
6.11	3.92	1.95	**11.98**	9.00	**10.03**	8.00	3.00	......	***3.00**	4.00	***2.34**	2.47	29.30	26.00	432
4.44	4.19	1.93	**10.56**	9.00	**8.63**	8.00	2.34	......	**2.34**	2.00	**1.06**	.82	21.75	18.00	604
														24.00	820
5.95	2.97	1.68	**10.60**	9.00	**8.92**	8.00	4.43	......	**4.43**	4.00	**.83**	.82	23.46	....	475
														19.00	327
														22.00	315
														21.00	251
														22.00	487
														22.00	818
														22.00	819
5.67	2.65	1.44	**9.76**	......	**8.32**	......	4.70	......	**4.70**	......	**1.19**	......	24.30	....	329
7.98	2.37	1.42	**11.77**	11.00	**10.35**	9.00	2.65	......	**2.65**	2.00	**2.36**	2.47	29.23	26.00	486
5.94	3.02	2.29	**11.25**	11.00	***8.96**	9.00	2.41	......	**2.41**	2.00	**2.47**	2.47	28.04	26.00	314
														24.00	497
6.44	2.64	1.94	**11.02**	9.00	**9.08**	8.00	2.38	......	**2.38**	2.00	**1.72**	1.65	25.10	26.00	488
														24.00	821
7.22	2.56	2.23	**12.01**	9.00	**9.78**	8.00	3.25	......	**3.25**	3.00	**2.12**	2.06	28.51	25.00	485
														22.25	545

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	LAZARETTO GUANO BRANCH, BALTIMORE, MD.		
338	Lazaretto Special Potato Fertilizer,	Walker Bros., Glade,	9.98
	MARYLAND BRANCH, BALTIMORE, MD.		
82	†Maryland O. K. Ammoniated,	J. H. Little, Gardners Sta.,	9.68
653		R. M. Gibson, Gibsonia,	
	MILSOM BRANCH, EAST BUFFALO, N. Y.		
831	Milsom's Buffalo Fertilizer,	George Miller, Kossuth,	10.63
424	†Milsom's Buffalo Guano,	Jacob Hollenbach, Shoemakersville,	8.99
833		George Miller, Kossuth,	
832	Milsom's Wheat, Oats and Barley,	George Miller, Kossuth,	10.66
	MORO-PHILIPS BRANCH, PHILADELPHIA, PA.		
766	†Moro-Philips Farmer's Phosphate,	Ewing & Kinsloe, Newton Hamilton,	9.12
767		Ewing & Kinsloe, Newton Hamilton,	
503	†Moro-Philips Potato Mixture,	N. E. Hunsicker, Mantz,	8.67
591		H. G. Supplee, Bloomsburg,	
504	Moro-Philips Special Fertilizer,	N. E. Hunsicker, Mantz,	8.37
	PACKER'S UNION BRANCH, NEW YORK.		
343	†Packer's Union American Wheat and Rye Grower,	I. G. Miller, Kimmel,	9.35
85		J. W. Glatfelter, Rossville,	
536		J. H. Kirk, East Waterford,	
345	†Packer's Union Animal Corn Fertilizer,	I. G. Miller, Kimmel,	9.96
472		Jas. Avery, Dushore,	
348	Packer's Union Gardeners' Complete Manure,	Ross Snyder, N. Lexington,	10.21
639	†Packer's Union Potato Manure,	C. A. Wagner, Buckstown,	8.72
474		Jas. Avery, Dushore,	
796		R. M. McDowell, Big Bend,	
344	†Packer's Union Universal Fertilizer,	I. G. Miller, Kimmel,	8.85
259		M. L. Kaufman, Atglen,	
349		Ross Snyder, N. Lexington,	
795		R. M. McDowell, Big Bend,	

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
6.23	3.32	1.42	**10.97**	9.00	**9.55**	8.00	4.21	......	**4.21**	4.00	**1.07**	.82	$24.58	$20.00	338
5.91	3.27	1.68	**10.86**	9.00	**9.18**	8.00	2.27	......	**2.27**	2.00	**1.08**	.82	22.46	18.50 19.00	82 653
5.84	2.40	3.67	**11.91**	9.00	**8.24**	8.00	2.14	......	**2.14**	1.50	**2.28**	2.06	27.07	26.00	831
4.95	3.46	2.46	**10.87**	9.00	**8.41**	8.00	4.30	......	**4.30**	4.00	***.81**	.82	22.81	20.00 24.00	424 833
6.03	3.20	2.23	**11.46**	9.00	**9.23**	8.00	2.00	.52	**2.52**	2.00	**1.12**	.82	23.17	23.00	832
5.56	3.40	.88	**9.84**	8.00	**8.96**	7.00	1.46	......	**1.46**	1.00	**1.14**	.82	21.20	17.25 17.25	766 767
4.86	2.42	2.06	**9.34**	7.00	**7.28**	6.00	5.38	......	**5.38**	5.00	**1.31**	1.24	24.51	22.00 27.00	503 591
4.92	2.93	2.46	**10.31**	9.00	***7.85**	8.00	3.51	......	**3.51**	3.00	***1.91**	2.06	25.75	23.00	504
5.13	3.68	1.02	**9.83**	9.00	**8.81**	8.00	2.19	......	**2.19**	2.00	**.91**	.82	20.86	18.00 18.00 21.00	343 85 536
7.30	2.63	1.91	**11.84**	11.00	**9.93**	9.00	2.32	......	**2.32**	2.00	**2.64**	2.47	29.79	23.00	345 472
5.26	2.83	1.85	**9.94**	7.00	**8.09**	6.00	7.06	......	***7.06**	10.00	**3.35**	3.30	35.13	29.00	348
6.89	2.28	2.46	**11.63**	9.00	**9.17**	8.00	4.89	......	***4.89**	6.00	**2.21**	2.06	30.06	21.75 .... 27.00	639 474 796
5.63	3.03	1.65	**10.31**	9.00	**8.66**	8.00	3.96	......	***3.96**	4.00	**1.06**	.82	23.41	20,00 16.00 20.00 22.50	344 259 349 795

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	QUINNIPIAC BRANCH, NEW YORK.		
58	†Quinnipiac Climax Phosphate,	Paxton Fl. & Feed Co., Bowmansdale,	10.38
742		S. B. Sechler, Drehrsville,	
59	†Quinnipiac Mohawk Fertilizer,	Paxton Fl. & Feed Co., Bowmansdale,	9.25
741		S. B. Sechler, Drehrsville,	
	REESE BRANCH, BALTIMORE, MD.		
495	Reese's Potato Manure,	Wm. H. Reitz, Lynport,	8.51
212	Reese's Potato Phosphate,	Oscar White, Tompkinsville,	11.53
	Sharpless & Carpenter Branch, Phila.		
40	†S. & C's Dissolved Phosphate for Potatoes and General Use,	J. Watson Croft, Ambler,	9.60
548		Fowler Ellis, Franklindale,	
547	S. & C's Farmer's Bone Phosphate,	Fowler Ellis, Franklindale,	10.98
41	†S. & C's Gilt Edge Potato and Tobacco Manure,	J. Watson Croft, Ambler,	10.34
176		L. A. Geiger, Joanna,	
39	S. & C's No. 1 Bone Phosphate,	J. Watson Croft, Ambler,	7.48
177	†S. & C's Potato, Corn and Truck Guano,	L. A. Geiger, Joanna,	9.58
758		J. I. Gross, Shindle,	
174	S. & C's Royal Spring Mixture,	L. A. Geiger, Joanna,	9.77
	Susquehanna Branch, Baltimore, Md.		
542	†Susquehanna Crop Grower,	A. B. Cranmer, Monroeton,	7.80
617		W. A. Barlets, Dauphin,	
541	†Susquehanna Potato Phosphate,	A. B. Cranmer, Monroeton,	10.43
422		Sol. H. Lenhart & Son, Hamburg,	
3		Jos Brown, Kelton,	
576		J. N. Getz, Lock Haven,	
616		W. A. Barlets, Dauphin,	
423	†Susquehanna XXV Phosphate,	Sol. H. Lenhart & Son, Hamburg,	7.94
95		Jas. Lean & Son, Dillsburg,	
577		J. N. Getz, Lock Haven,	
618		W. A. Barlets, Dauphin,	

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†Composite sample.

IZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.93	3.63	1.54	**10.10**	9.00	**8.56**	8.00	2.11	......	**2.11**	2.00	**1.16**	1.03	$21.68	$20.00 20.00	58 742
4.24	3.64	1.06	**8.94**	8.00	**7.88**	7.00	1.22	......	**1.22**	1.00	**.90**	.82	18.74	18.00 16.00	59 741
5.63	3.22	1.08	***9.93**	10.00	***8.85**	9.00	6.84	......	***6.84**	7.00	**1.00**	.82	26.11	28.00	495
6.14	2.29	2.04	**10.47**	9.00	**8.43**	8.00	5.65	......	***5.65**	6.00	***1.85**	2.06	28.32	....	212
3.69	4.51	2.42	**10.62**	8.00	**8.20**	7.00	6.05	......	**6.05**	1.00	**2.09**	.82	29.34	27.00 25.00	40 548
5.33	3.31	1.66	**10.30**	......	**8.64**	......	4.22	......	**4.22**	......	**1.18**	......	24.21	19.00	547
5.32	3.06	1.54	**9.92**	9.00	**8.38**	8.00	10.17	......	**10.17**	10.00	***1.57**	1.65	31.30	28.00 28.00	41 176
2.30	5.08	2.80	**10.18**	9.00	***7.38**	8.00	2.26	......	**2.26**	2.00	**1.68**	1.65	23.04	22.00	39
3.50	2.88	1.43	**7.81**	7.00	**6.38**	6.00	4.94	......	***4.94**	5.00	**1.37**	1.24	22.81	22.00 21.00	177 758
4.89	3.59	1.80	**10.28**	9.00	**8.48**	8.00	2.11	......	**2.11**	2.00	**.89**	.82	20.74	20.00	174
3.40	5.56	1.20	**10.16**	8.00	**8.96**	7.00	1.34	......	**1.34**	1.00	**.99**	.82	20.40	19.00 22.00	542 617
6.65	2.02	1.71	**10.38**	9.00	**8.67**	8.00	5.50	......	**5.50**	5.00	***1.54**	1.65	27.18	26.00 26.00 25.00 30.00 28.00	541 422 3 576 616
3.87	4.55	1.12	**9.54**	9.00	**8.42**	8.00	1.31	......	**1.31**	1.00	**.92**	.82	19.42	18.00 20.00 28.00 23.00	423 95 577 618

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	Tygert-Allen Branch, Philadelphia, Pa.		
500	†Tygert-Allen's Popular Phosphate,	F. S. Balliet, East Penn,	9.8
437		J. Singwaster & Co., Macungie,	
540		J. L. Ward, S. Towanda,	
436	Tygert-Allen's Special Brand Potato Manure,	J. Singwaster & Co., Macungie,	10.09
350	†Tygert-Allen's Special for Wheat and Grass,	R. S. McMillen, Kingwood,	8.50
435		J. Singwaster & Co., Macungie,	
62	Tygert-Allen's Standard Bone Phosphate,	Paxton Fl. & Feed Co., Bowmansdale,	13.46
61	Tygert-Allen's Star Potato Grower,	Paxton Fl. & Feed Co., Bowmansdale,	9.20
	Wheeler Branch, Rutland, Vt.		
448	†Wheeler's Corn Fertilizer,	W. A. Fish, Dimock,	9.39
222		J. W. Zeigler, Rebersburg,	
794		R. M. McDowell, Big Bend,	
449	†Wheeler's Royal Wheat Grower,	W. A. Fish, Dimock,	9.18
252		William Jones, Kelton,	
170		H. B. Best, Joanna,	
456		E. H. Thomas, Springville,	
793		R. M. McDowell, Big Bend,	
447	Wheeler's Potato Manure,	W. A. Fish, Dimock,	9.26
	Williams & Clark Branch, New York.		
434	†Williams & Clark's American H. G. Special,	J. Singwaster & Co., Macungie,	8.28
505		N. E. Hunsicker, Mantz,	
145	†Williams & Clark's Good Grower Potato Phosphate,	F. W. Lindner, Pottsgrove,	9.07
770		Wm. M. Atkinson, McVeytown,	
769	Williams & Clark's Prolific Fertilizer,	Wm. M. Atkinson, McVeytown,	8.20
144	Williams & Clark's Royal Bone Phosphate,	F. W. Lindner, Pottsgrove,	10.03
	American Reduction Co., Pittsburg, Pa.		
113	†Common Sense,	John Weaver, Benton Borough,	10.9
798		C. E. McQuiston, Cyrus,	
112	†Vegetable Manure,	John Weaver, Benton Borough,	8.41
797		C. E. McQuiston, Cyrus,	

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†Composite sample.

IZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2 000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
6.06	3.08	1.51	**10.65**	9.00	**9.14**	8.00	2.42	.....	**2.42**	2.00	**1.04**	.82	$22.34	$20.00	500
														19.50	437
														21.00	540
5.75	2.34	2.26	**10.35**	9.00	**8.09**	8 00	6.98	.....	**6.98**	6.00	***1.95**	2.06	29.79	26.50	436
4.68	3.42	1.25	**9.35**	8.00	**8.10**	7.00	1.37	.....	**1.37**	1.00	**1.00**	.82	19.65	17.00	350
														18.00	435
7.87	1.84	.84	**10.55**	9.00	**9.71**	8.00	2.17	......	**2.17**	2.00	**1.74**	1.65	25.36	22.00	62
2.91	3.68	1.21	**7.80**	7.00	**6.59**	6.00	6.62	......	**6.62**	5.00	**1.84**	1.24	26.52	25.00	61
7.31	2.07	1.52	**10.90**	9.00	**9.38**	8.00	2.42	......	**2.42**	2.00	**1.80**	1.65	25.72	21.50	448
														21.00	222
														22.00	794
5.98	2.97	1.72	**10.67**	9.00	**8.95**	8.00	2.67	......	**2.67**	2.00	**1.08**	.82	22.66	19.00	449
														19.00	252
														18.00	170
														22.00	456
														20.50	793
6.98	2.16	2.50	**11.64**	9.00	**9.14**	8.00	3.61	......	**3.61**	3.00	**2.12**	2.06	28.32	24.00	447
5.00	2.82	2.46	**10.28**	9.00	***7.82**	8.00	6.94	......	**6.94**	7.00	***2.99**	3.30	33.63	32.00	434
														32.00	505
4.66	3.26	1.38	**9.30**	7.00	**7.92**	6.00	4.69	......	***4.69**	5.00	**1.37**	1.24	24.32	24.00	145
														23.00	770
3.72	4.54	1.12	**9.38**	8.00	**8.26**	7.00	1.34	......	**1.34**	1.00	**.97**	.82	19.50	18.00	769
6.90	2.19	1.39	**10.48**	9.00	**9.09**	8.00	2.38	.....	**2.38**	2.00	**1.06**	1.03	22.34	24.00	144
1.52	2.66	6.27	**10.45**	7.00	***4.18**	6.00	1.18	......	**1.18**	1.00	**1.75**	1.65	20.29	18.00	113
														18.00	798
3.45	3.00	3.65	**10.10**	7.00	**6.45**	6.00	7.49	......	**7.49**	6.00	***2.06**	2.47	29.31	26.00	112
														23.00	797

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*Constituent falls below guaranty.

COMPLETE FERT

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	The Armour Fertilizer Works, Chicago, Ill.		
120	Bone, Blood and Potash,	J. W. Painter & Co., Red Top,	8.5
380	†Fruit and Root Crop Special,	D. E. Brown, East Berlin,	8.2
321		Wallace Sherbine, Willmore,	
121		J. W. Painter & Co., Red Top,	
678		J. S. Hershberger, Everett,	
759		Isaac Shirley, McClure,	
322	†Grain Grower,	Wallace Sherbine, Willmore,	8.0
123		J. W. Painter & Co., Red Top,	
630		Smith & Son, Mt. Pleasant,	
682		J. S. Hershberger, Everett,	
370	†H. G. Potato,	Smith & Son, Mt. Pleasant,	7.6
679		J. S. Hershberger, Everett,	
29	†Royal Ammoniated Bone,	Passmore & Gillespie, Nottingham,	9.5
381		D. E. Brown, East Berlin,	
611	Special Mixture,	J. A. Romberger, Elizabethville,	8.0
320	†Wheat, Corn and Oats Special,	Wallace Sherbine, Willmore,	7.7
122		J. W. Painter & Co., Red Top,	
631		Smith & Son, Mt. Pleasant,	
	R. S. Aucker, Shamokin, Pa.		
627	Bone and Slaughter House Phosphate, Grade A,	Geo. R. Hendricks, Selinsgrove,	5.7
629	Bone and Slaughter House Phosphate, Grade B,	Geo. R. Hendricks, Selinsgrove,	5.1
755	Bone and Slaughter House Phosphate, Grade D,	Geo. R. Hendricks, Selinsgrove,	5.8
756	Bone and Slaughter House Phosphate, Grade E,	Geo. R. Hendricks, Selinsgrove,	8.4
757	Pure Bone Meal with Potash,	Geo. R. Hendricks, Selinsgrove,	4.18
	Baltimore Pulverizing Co., Baltimore, Md.		
641	Farmers' Favorite Fertilizer,	Cyrus Burkbill, Kantner,	4.54
451	H. G. Potato Guano,	F. H. Bunnell, Dimock,	7.30
450	Penniman's Special Guano No. 1,	F. H. Bunnell, Dimock,	6.71
581	Special Potato Mixture,	D. R. Wertz, Shinton,	5.47
580	Truckers' Choice,	D. R. Wertz, Shinton,	6.37

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
.92	.77	.85	*9.54	10.00	8.69	8.00	6.74	......	*6.74	7.00	*3.98	4.12	$37.89	$36.00	120
.02	1.52	.90	*9.44	10.00	8.54	8.00	5.00	......	5.00	5.00	*1.60	1.65	26.35	25.00	380
														20.00	321
														26.00	121
														26.00	678
														24.00	759
6.60	2.24	1.02	*9.86	10.00	8.84	8.00	2.22	......	2.22	2.00	*1.64	1.65	24.02	25.00	322
														23.00	123
														24.00	630
														25.00	682
5.58	2.53	1.33	*9.44	10.00	8.11	8.00	10.90	......	10.90	10.00	*1.52	1.65	31.57	35.00	370
														36.00	679
5.60	2.75	1.03	*9.38	10.00	8.35	8.00	4.11	......	4.11	4.00	*.78	.82	21.96	23.00	29
														22.00	381
4.98	3.13	1.43	*9.54	10.00	8.11	8.00	1.17	......	1.17	1.00	.51	.41	13.56	16.00	611
5.27	2.63	.89	*8.79	9.00	7.90	7.00	1.33	......	1.33	1.00	.99	.82	19.34	20.00	320
														21.00	122
														22.00	631
4.02	3.31	4.06	*11.39	12.00	*7.33	9.00	3.55	......	3.55	3.00	1.81	1.65	25.52	26.00	627
4.03	3.20	3.21	*10.44	11.00	*7.23	9.00	3.31	......	3.31	3.00	*1.14	1.65	22.18	24.00	629
3.28	3.99	2.83	10.10	10.00	*7.27	8.00	2.94	......	*2.94	3.00	1.13	.82	21.60	21.00	755
5.64	2.65	2.27	10.56	10.00	8.29	8.00	2.50	......	*2.50	3.00	*.75	.82	20.66	19.00	756
0.00	6.83	7.59	14.42	14.00	6.83	6.00	4.07	......	4.07	......	2.64	......	30.02	29.00	757
1.34	4.28	1.45	7.07	......	5.62	3.50	1.83	......	1.83	1.50	*.73	.82	16.17	17.87	641
1.89	5.54	2.73	10.16	......	7.43	......	10.40	......	10.40	......	1.83	......	31.92	28.60	451
1.64	6.63	2.60	10.87	......	8.27	8.00	1.27	......	1.27	1.00	1.15	.82	20.59	18.60	450
1.90	4.08	1.42	7.40	......	5.98	......	4.52	......	4.52	......	1.06	......	20.54	20.75	581
3.56	5.45	1.88	10.89	......	9.01	......	1.91	......	1.91	......	2.52	......	27.31	23.00	580

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	Baugh & Sons Co, Philadelphia, Pa.		
394	Ammoniated Soluble Alkaline,	J. U. Ruff, New Oxford,	7.89
562	Animal Compound for all Crops,	Sarah Wessinger, Watsontown,	10.25
388	†Corn Fertilizer for Sugar Corn and Garden Truck,	Sheffer & Frey, Hanover,	8.14
324		C. H. Schmucker, Freidens,	
102		P. J. Blough, Hooversville,	
395		J. U. Ruff, New Oxford,	
606		J. A. Romberger, Elizabethville,	
358	†Double Eagle Phosphate,	M. R. Thomas, Somerfield,	9.24
393		J. U. Ruff, New Oxford,	
101	†Export Bone with Potash,	P. J. Blough, Hooversville,	5.60
359		A. Gaddis & Co., Uniontown,	
103	†General Crop Grower for all Crops,	P. J. Blough, Hooversville,	10.55
318		Jacob Stattler, Elton,	
42		J. Watson Croft, Ambler,	
325		C. H. Schmucker, Freidens,	
383		D. E. Brown, East Berlin,	
608		J. A. Romberger, Elizabethville,	
89	†Potato Fertilizer,	S. N. Bailey & Bro., Dillsburg,	8.39
105		P. J. Blough, Hooversville,	
561	†Special Potato Manure,	Sarah Wessinger, Watsontown,	8.56
36		J. Watson Croft, Ambler,	
607		J. A. Romberger, Elizabethville,	
316	Special Potato Mixture,	Jacob Stattler, Elton,	9.12
317	†$25 Phosphate	Jacob Stattler, Elton,	10.53
38		J. Watson Croft, Ambler,	
609		J. A. Romberger, Elizabethville,	
	The Berg Co., Philadelphia, Pa.		
599	$35 Potato Manure,	David W. Cooper, Sunbury,	4.76
603	$25 Special Bone Manure,	Geo. Deppen, Herndon,	5.21

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
5.92	2.49	2.59	**11.00**	......	**8.41**	8.00	2.22	......	**2.22**	2.00	**.59**	.41	$15.70	$16.00	304
6.07	2.70	2.67	**11.44**	......	**8.77**	8.00	2.41	......	**2.41**	2.00	**1.93**	1.65	26.08	....	562
5.13	3.20	2.31	**10.64**	......	**8.33**	8.00	4.65	......	**4.65**	4.00	**1.15**	.82	24.44	22.00	388
														....	324
														23.00	102
														21.00	395
														21.00	606
5.22	3.65	2.33	**11.20**	......	**8.87**	8.00	1.28	......	**1.28**	1.00	**1.96**	1.65	24.78	22.00	358
														23.00	393
.45	5.14	8.32	**13.91**	......	*5.59	11.00	2.69	......	**2.69**	2.00	**2.03**	1.65	25.38	27.00	101
														25.00	359
6.25	2.75	2.42	**11.42**	......	**9.00**	8.00	1.73	......	**1.73**	1.00	**1.01**	.82	21.78	20.00	103
														20.00	318
														19.00	42
														....	325
														20.00	383
														17.00	608
6.72	2.65	2.62	**11.99**	......	**9.37**	3.50	2.18	......	*2.18	5.00	*1.68	3.30	25.59	22.00	89
														25.00	165
3.64	2.49	2.19	**8.32**	......	**6.13**	5.00	10.21	......	**10.21**	10.00	**1.84**	1.65	30.25	....	561
														20.00	36
														26.00	607
3.90	2.17	2.28	**8.35**	......	**6.07**	5.00	10.22	......	**10.22**	10.00	**1.85**	1.65	30.25	29.00	316
5.21	3.84	2.68	**11.73**	......	**9.05**	8.00	1.52	......	**1.52**	1.00	**1.83**	1.65	24.97	23.50	317
														23.00	38
														21.00	609
3.16	3.92	5.52	**12.60**	......	**7.08**	7.00	9.46	......	*9.46	10.00	**2.52**	2.47	34.63	35.00	599
4.75	3.28	4.59	**12.62**	......	**8.03**	7.00	2.63	......	**2.63**	2.00	*1.63	1.65	25.06	25.00	603

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*Constituent falls below guaranty.

COMPLETE FERTI

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	A. H. Blaker & Co. Fox Chase, Pa.		
12	Special for Potatoes,	Patterson Ramsey, Kelton,	9.67
	Bowker Fertilizer Co., Boston, Mass.		
445	Ammoniated O. I. O. Phosphate,	O. P. Beebe, Montrose,	10.32
583	Farm and Garden Phosphate,	Bailey & Blair, Wellsboro,	13.41
364	Fish Guano,	Loucks & Morrow, Scottdale,	10.20
311	Hill and Drill Phosphate,	A. Hostetler, Geistown,	10.14
310	Market Garden Fertilizer,	A. Hostetler, Geistown,	9.01
823	Potash Bone,	Amos Meyers, Sligo,	12.59
309	†Potash or Staple Phosphate,	A. Hostetler, Geistown,	12.35
824		Amos Meyers, Sligo,	
193	Potato or Staple Phosphate,	E. Cobley, Daleville,	10.84
365	6 Per Cent. Potash Fertilizer,	Loucks & Morrow, Scottdale,	8.49
308	†6 Per Cent. Potato Fertilizer,	A. Hostettler, Geistown,	12.15
587		Bailey & Blair, Wellsboro,	
306	Stockbridge Special Complete Manure,	A. Hostetler, Geistown,	9.03
467	†Sure Crop Phosphate,	P. H. Taylor, Rome,	
192		E. Cobley & Son, Daleville,	
584		Bailey & Blair, Wellsboro,	
830		James McGuire, Knox,	
	Cambria Fertilizer Co., Johnstown, Pa.		
697	Corn and Potato Manure,	H. A. Shoemaker, Ebensburg,	6.11
664	†Standard Phosphate,	Herman Neafer, Altoona,	6.45
116		M. A. Zimmerman, Critchfield,	
696		H. A. Shoemaker, Ebensburg,	
	The Chicago Fertilizer Co., Chicago, Ill.		
792	Blood, Bone and Potash,	L. B. Gilmore, Wesley,	8.60
	Henry Cope & Co., Lincoln University, Pa.		
35	Ammoniated Bone Phosphate,	Passmore & Gillespie, Nottingham,	9.55
34	Potato and Corn Phosphate,	Passmore & Gillespie, Nottingham,	12.59
296	Pure Bone Phosphate,	Henry Cope & Co., Oxford,	9.11

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.[illegible]	3.45	1.85	**9.83**	......	**7.98**	8.00	8.28	......	**8.28**	8.00	**1.12**	1.03	$27.31	$25.00	12
4.33	5.63	4.35	**14.31**	11.00	***9.96**	10.00	.42	......	**.42**	......	**.84**	.50	16.24	17.00	445
4.84	3.28	3.52	**11.64**	9.00	**8.12**	8.00	2.11	......	**2.11**	2.00	**1.60**	1.50	23.95	30.00	583
3.73	4.65	5.00	**13.38**	.....	**8.38**	......	4.26	......	**4.26**	......	**.86**	......	24.03	28.00	364
4.71	6.02	2.83	**13.56**	10.00	**10.73**	9.00	2.12	......	**2.12**	2.00	**2.39**	2.25	29.54	25.00	311
2.08	4.90	2.88	**9.86**	7.00	**6.98**	6.00	8.58	......	***8.58**	10.00	**2.33**	2.25	31.66	30.00	310
3.69	3.40	1.81	**8.90**	7.00	**7.09**	6.00	2.00	......	**2.00**	2.00	**.95**	.75	19.18	23.00	823
3.84	3.97	3.07	**10.88**	9.00	***7.81**	8.00	3.15	......	**3.15**	3.00	**.90**	.75	21.58	19.00 26.00	309 824
3.16	4.15	2.51	**9.82**	9.00	***7.31**	8.00	2.99	......	***2.99**	3.00	**.88**	.75	20.49	22.50	193
.90	4.82	3.82	**9.54**	7.00	***5.72**	6.00	7.61	......	**7.61**	6.00	**1.07**	.75	24.46	30.00	365
4.66	3.49	2.32	**10.47**	7.00	**8.15**	6.00	5.34	......	***5.34**	6.00	**.88**	.75	23.89	24.00 30.00	308 587
3.83	2.77	3.52	**10.12**	.....	**6.60**	......	10.52	......	**10.52**	......	**3.36**	......	37.66	35.00	306
4.70	3.44	3.19	**11.33**	10.00	***8.14**	9.00	2.47	......	**2.47**	2.00	**.91**	.75	21.37	23.00 19.80 25.00 25.00	467 192 584 830
5.63	2.55	2.00	**10.18**	7.00	**8.18**	6.00	5.47	3.38	**8.85**	8.00	**1.82**	1.50	31.66	32.00	697
4.44	3.21	2.23	**9.88**	7.00	**7.65**	6.00	4.44	......	**4.44**	3.00	**1.73**	1.50	25.75	26.00 25.00 25.00	664 116 696
4.06	4.77	1.32	**10.15**	9.00	**8.83**	8.00	1.99	......	***1.99**	2.00	**1.31**	1.24	22.26	28.00	792
2.16	5.69	2.52	***10.37**	11.00	***7.85**	9.00	2.73	......	**2.73**	2.00	**.92**	.82	20.71	21.00	35
3.74	4.27	.93	***8.94**	9.00	**8.01**	8.00	4.26	......	**4.26**	4.00	**1.29**	1.24	23.43	24.00	34
3.25	5.34	4.46	**13.05**	9.00	**8.59**	8.00	2.46	......	**2.46**	2.00	**2.23**	1.65	27.63	....	296

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*Constituent falls below guaranty.

COMPLETE FERT

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
	Josiah Cope & Co., Lincoln University, Pa.		
293	Ammoniated Bone Phosphate,	Josiah Cope & Co., Oxford,	9.00
289	Pure Bone Phosphate,	Josiah Cope & Co., Oxford,	6.97
292	"Try Me" Bone Phosphate,	Josiah Cope & Co., Oxford,	10.17
294	Wheat and Grass Special,	Josiah Cope & Co., Oxford,	12.83
	E. Daron, Dover, Pa.		
418	Harvest King Bone Phosphate,	E. Daron, Dover,	12.15
	Jas. G. Downward & Co., Coatesville, Pa.		
43	Ammoniated Bone Phosphate,	Geo. W. Niblock, Ambler,	8.52
45	Royal Bone Phosphate,	Geo. W. Niblock, Ambler,	9.66
48	Special Asparagus Mixture,	Geo. W. Niblock, Ambler,	7.60
46	Special Corn Manure,	Geo. W. Niblock, Ambler,	6.45
44	Special Potato Fertilizer,	Geo. W. Niblock, Ambler,	10.45
47	Special Wheat and Grass Fertilizer,	Geo. W. Niblock, Ambler,	6.77
	Eureka Fertilizer Co., Perryville, Md.		
368 285 410 525	†Corn and Potato Special,	C. S. Funk, New Stanton, Lewis H. Kirk & Co., Nottingham, F. H. Shenberger, Brownton, Dimm & Kiser, Thompsontown,	9.28
286	Fish, Rock and Potash,	Lewis H. Kirk & Co., Nottingham,	8.95
408	Imperial Bone Phosphate,	F. H. Shenberger, Brownton,	9.08
287 407	†Potato and Vegetable Fertilizer,	Lewis H. Kirk & Co., Nottingham, F. H. Shenberger, Brownton,	7.71
	Washington Ewing, Landenberg, Pa.		
24	Eclipse Raw Bone Super Phosphate,	Passmore & Gillespie, Nottingham,	8.49
23	Waste Land Potato Phosphate,	Passmore & Gillespie, Nottingham,	8.89
	Griffith & Boyd, Baltimore, Md.		
21 166	†Ammoniated Bone Phosphate,	F. A. Hamilton, Sylmar, Adam Krug, Allenwood,	11.33
146	Cereal Bone Plant Food,	Jacob Hummel, Red Top,	12.31

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†Composite sample.

IZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
.66	3.52	.91	**12.09**	11.00	**11.18**	10.00	3.52	......	**3.52**	3.00	**.87**	.82	$24.80	$20.00	293
.83	4.57	5.68	**14.08**	12.00	**8.40**	8.00	4.31	......	**4.31**	3.00	**2.17**	1.65	29.59	27.00	289
.45	2.75	2.04	**12.24**	12.00	**10.20**	10.00	4.78	......	**4.78**	4.00	**2.36**	1.65	31.51	23.00	292
1.66	7.59	.59	**9.84**	9.00	**9.25**	8.00	1.19	......	**1.19**	1.00	**1.01**	.82	20.06	17.00	294
.66	3.01	.61	***9.28**	10.00	**8.67**	8.00	5.35	......	**5.35**	5.00	***1.47**	1.65	25.98	22.00	418
.85	4.50	2.29	**9.64**	9.00	***7.35**	8.00	2.71	......	**2.71**	2.50	**1.33**	1.24	21.90	25.00	43
.48	2.90	2.65	**10.03**	9.00	***7.38**	8.00	2.74	......	**2.74**	2.00	**.86**	.82	20.38	22.00	45
.38	2.10	1.29	**5.77**	5.00	**4.48**	3.00	5.65	......	**5.65**	5.00	***5.91**	8.24	39.24	40.00	48
.12	4.05	2.72	***10.89**	11.00	***8.17**	9.00	3.27	......	***3.27**	3.50	**1.69**	1.65	25.10	30.00	46
.89	3.69	2.19	**9.77**	9.00	***7.58**	8.00	4.45	......	**4.45**	4.00	**1.69**	1.65	25.38	28.00	44
.73	4.24	2.78	**10.75**	9.00	***7.97**	8.00	3.04	......	**3.04**	3.00	***1.63**	1.65	24.46	30.00	47
5.69	3.81	4.71	**14.21**	11.00	**9.50**	9.00	2.12	......	***2.12**	3.00	**.82**	.82	17.79	22.00	368
														21.00	285
														21.00	410
														20.00	525
.37	3.83	4.01	**13.21**	9.00	**9.20**	8.00	.85	......	***.85**	1.00	**.60**	.41	15.25	16.50	286
.36	4.28	6.23	**15.87**	9.00	**9.64**	8.00	1.10	......	**1.10**	1.00	***.73**	.82	17.17	18.00	408
.64	3.85	4.48	**13.97**	10.00	**9.49**	8.00	1.53	......	***1.53**	4.00	***1.43**	1.65	24.81	22.00	287
														21.00	407
4.24	4.93	4.33	**13.50**	9.00	**9.17**	7.00	2.76	......	**2.76**	2.00	***1.11**	1.24	24.08	24.00	24
4.34	4.53	4.75	**13.62**	5.00	**8.87**	3.00	2.36	......	***2.36**	3.00	**1.14**	.82	23.72	24.00	23
5.75	2.37	2.66	**10.78**	9.00	**8.12**	8.00	2.91	......	**2.91**	2.00	**1.65**	1.65	24.67	20.00	21
														22.00	166
5.91	3.16	2.03	**11.10**	9.00	**9.07**	8.00	2.73	......	**2.73**	2.00	***.79**	.82	21.85	19.50	146

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
71	†Farmers' Potato Manure,	E. J. Myers, York Springs,	10.78
22		F. A. Hamilton, Sylmar,	
528		Wm. Kipp, Millerstown,	
656	Fish, Bone and Potash,	W. H. Heckert, Bakerstown,	10.33
147	†Peerless Fertilizer,	Jacob Hummel, Red Top,	13.24
70		E. J. Myers, York Springs,	
303		J. M. Harshberger, Johnstown,	
657		W. H. Heckert, Bakerstown,	
655	Royal Potash Guano,	W. H. Heckert, Bakerstown,	10.43
333	†Spring Crop Grower,	Jas. D. Miller, Rockwood,	10.86
302		J. M. Harshberger & Sons, Johnstown,	
658		W. H. Heckert, Bakerstown,	
149	†Valley Fertilizer,	Jacob Hummel, Red Top,	14.03
72		E. J. Myers, York Springs,	
301		J. M. Harshberger & Sons, Johnstown,	
	Hanover Fertilizer Co., Baltimore, Md.		
237	†Farmers' Crop Winner,	Isenberg Milling Co., Huntingdon,	7.82
386		H. F. Stambaugh, Abbottstown,	
114	Klondyke Special,	Josiah Specht, Kantner,	10.31
230	†Klondyke Special for Potatoes and Tobacco,	E. M. Soope, Petersburg,	8.50
385		H. F. Stambaugh, Abbottstown,	
	Frank Hartranft, Coatesville, Pa.		
265	Ammoniated Bone Phosphate,	Jos. Worrall, Parkesburg,	9.15
263	Special Phosphate,	Jos. Worrall, Parkesburg,	8.05
	W. S. Hastings & Son, Atglen, Pa.		
256	Soluble Bone and Potash,	W. S. Hastings & Son, Atglen,	14.43
	S. M. Hess & Bro., Philadelphia, Pa.		
815	No. 2 Keystone Bone,	J. N. Williamson, Harrisville,	6.65
509	Potato and Truck Manure,	John Brown, Mantz,	8.80
417	The Scientific Manure,	Daniel Spangler, Red Lion,	8.97

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
.32	2.40	1.76	**10.48**	9.50	**8.72**	8.00	9.25	......	**9.25**	9.00	***.73**	.82	$27.86	$25.00 23.75 24.00	71 22 528
.18	2.83	2.31	**9.32**	8.00	**7.01**	7.00	3.05	......	**3.05**	3.00	**1.75**	1.44	23.61	21.00	656
.15	4.43	2.49	**11.07**	......	**8.58**	8.00	2.59	......	**2.59**	2.00	**.34**	.29	14.97	16.50 15.00 18.00 16.00	147 70 203 657
.56	3.62	2.60	**10.78**	9.00	**8.18**	8.00	4.18	......	**4.18**	4.00	**.87**	.82	22.71	22.00	655
.10	2.92	2.18	**10.20**	7.50	**8.02**	6.50	4.59	......	**4.59**	4.50	***1.63**	1.65	25.94	.... 27.00 23.00	333 302 658
.51	2.57	1.70	**10.78**	9.00	**9.08**	8.00	3.21	......	**3.21**	3.00	**.53**	.41	16.70	18.50 18.00 24.00	149 72 301
.99	5.34	1.91	**9.24**	8.00	**7.33**	7.00	2.51	......	**2.51**	1.50	**.41**	.41	13.88	19.00 17.00	237 386
.37	3.68	2.13	**9.18**	9.00	***7.05**	8.00	4.76	......	**4.76**	4.00	***1.61**	1.65	24.63	25.00	114
.22	4.08	2.13	**9.43**	9.00	***7.30**	8.00	4.65	......	**4.65**	4.00	***1.63**	1.65	24.98	24.00 23.00	230 385
.82	5.00	7.97	**16.79**	15.00	***8.82**	10.00	1.97	......	**1.97**	1.50	***1.42**	2.06	25.77	25.00	265
.95	6.93	5.25	**17.13**	15.00	***11.88**	14.00	1.73	......	***1.73**	2.50	***.56**	.82	18.01	22.00	263
.15	2.08	2.82	**12.05**	......	***9.23**	10.00	2.17	......	**2.17**	2.00	**.72**	......	16.78	14.00	256
.33	4.09	1.92	**11.34**	10.00	**9.42**	8.00	1.56	......	**1.56**	1.00	**1.02**	.82	21.70	23.00	815
.12	2.26	1.79	**11.17**	10.00	**9.38**	8.00	6.48	......	**6.48**	6.00	**2.50**	2.47	32.76	30.00	509
.41	4.16	1.40	**7.97**	7.00	**6.57**	6.00	4.92	......	***4.92**	5.00	**1.49**	1.24	23.38	27.50	417

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds
416	†Special Compound,	Daniel Spangler, Red Lion,	8.
513		Faust & Imboden, Orwigsburg,	
508	†Special Corn Manure,	John Brown, Mantz,	8.
514		Faust & Imboden, Orwigsburg,	
	Hubbard Fertilizer Co., Baltimore, Md.		
569	Royal Ensign for Early Market Vegetables,	S. G. Updegroff, Williamsport,	8.
570	Truckers' 7 Per Cent. Royal Seal Compound,	S. G. Updegroff, Williamsport,	12.
	M. P. Hubbard & Co., Baltimore, Md.		
207	Bermuda 7 Per Cent. Guano,	Richard Graves, Tompkinsville,	8.
502	Celebrated Bone Phosphate,	Chas. Andrews, Sitlers,	11.
63	†Excelsior Bone Phosphate,	Geo. Arnold, York county,	12.
751		R. F. Schwarz, Analomink,	
206	Farmers' Acme Fertilizer,	Richard Graves, Tompkinsville,	8.
501	†Farmers' Old Economy Phosphate,	Charles Andrews, Sitlers,	11.
352		Kregar & Son, Kingwood,	
49		E. A. Keasey, Dillsburg,	
531		Wm. Lindsey, Millerstown,	
750		R. F. Schwarz, Analomink,	
210	Pennsylvania Special Potato Grower,	Richard Graves, Tompkinsville,	9.0
	Jarecki Chemical Co., Sandusky, O.		
652	†Fish and Potash Potato and Tobacco Food,	S. J. Saint, Sharpsburg,	....
99		Wm. J. Horner, Quemahoning,	11.9
780		J. K. Hagerty, East Sandy,	
782	†Lake Erie Fish Guano,	J. K. Hagerty, East Sandy,	
98		Wm. J. Horner, Quemahoning,	12.7
787		G. A. Blair, Wesley,	....
779	†O. K. Fertilizer,	J. K. Hagerty, East Sandy,	5.2
97		Wm. J. Horner, Quemahoning,	
807		Sprowell Bros., Boyers,	
	T. S. Kenderdine & Sons, Newtown, Pa.		
270	Kenderdine's Ammoniated Phosphate,	T. S. Kenderdine & Sons, Newtown,	7.52

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†Composite sample.

IZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
.02	2.88	1.42	**10.32**	10.00	**8.90**	8.00	4.43	......	**4.43**	4.00	**.95**	.82	$23.71	$25.00	416
														24.00	513
.49	2.62	2.09	**11.20**	10.00	**9.11**	8.00	3.04	......	**3.04**	2.00	**1.01**	.82	23.08	20.00	508
														23.00	514
.35	1.58	3.13	**11.06**	......	***7.93**	8.00	4.28	......	**4.28**	5.00	***2.19**	2.47	28.34	26.00	569
.46	2.13	1.02	**12.61**	7.00	**11.59**	6.00	2.34	......	***2.34**	5.00	***1.83**	5.77	28.28	35.00	570
.97	2.07	.85	**8.89**	8.50	**8.04**	7.00	4.86	......	**4.86**	4.00	***5.43**	5.77	40.76	33.00	207
.76	2.95	1.38	**11.09**	......	**9.71**	9.00	2.54	......	**2.54**	2.00	***1.59**	1.65	25.30	20.00	502
.58	3.74	.91	**11.23**	9.50	**10.32**	8.00	1.66	......	**1.66**	1.50	**.86**	.82	21.86	20.00	63
														22.00	751
.19	2.64	1.49	**10.32**	......	**8.83**	7.00	2.52	......	**2.52**	2.00	***1.47**	1.65	23.71	22.00	206
.60	3.42	.93	**10.95**	......	**10.02**	8.00	1.94	......	**1.94**	1.50	**.76**	.41	21.42	15.00	501
														16.50	352
														17.50	49
														....	531
														21.00	750
.54	2.02	1.23	**8.79**	......	**7.56**	6.00	5.60	......	**5.60**	5.00	***.64**	1.24	22.11	22.00	210
.15	3.32	1.66	**12.13**	9.00	**10.47**	8.00	1.60	1.96	***3.56**	4.00	**.88**	.82	24.93	24.00	652
														24.00	99
														30.00	780
65	4.44	1.78	**12.87**	11.00	**11.09**	10.00	1.11	......	**1.11**	1.00	**1.70**	1.65	25.89	....	782
														23.50	98
														28.00	787
44	3.73	1.52	**7.69**	7.00	**6.17**	6.00	.....	.60	**.60**	.50	**.52**	.41	14.82	19.00	779
														14.00	97
														20.00	807
15	4.91	1.29	**12.35**	12.00	**11.06**	11.00	2.44	......	**2.44**	2.00	**1,50**	1.24	26.13	24.00	270

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
269	Kenderdine's Bone Phosphate,	T. S. Kenderdine & Sons, Newtown,	8.1
268	Kenderdine's Potato Phosphate,	T. S. Kenderdine & Sons, Newtown,	10.2
	Lackawanna Fert. & Chem. Co., Moosic, Pa.		
196	†Big Yield,	R. J. Tanfield, Daleville,	6.8
773		Miles Mattern, Scotia,	
201	†Bone Super Phosphate,	R. J. Tanfield, Daleville,	8.7
138		Geo. M. Walter, Milton,	
556		S. W. Lyons & Son, Canton,	
775	†Kali Chief,	Miles Mattern, Scotia,	7.4
200		R. J. Tanfield, Daleville,	
772		Miles Mattern, Scotia,	
429	†Our Admiral,	Henry G. Stamm, Leesport,	7.1
194		R. J. Tanfield, Daleville,	
552		S. W. Lyons & Son, Canton,	
555	†Special Manure,	S. W. Lyons & Son, Canton,	8.5
218		John Eaves, Stormstown,	
774		Miles Mattern, Scotia,	
195	†Wyoming Guano,	R. .J Tanfield, Daleville,	7.67
139		Geo. M. Walter, Milton,	
582		Wm. Norman, Sebrings,	
	B. F. Lebernight, Red Lion, Pa.		
411	Standard Ammoniated Bone Phosphate,	Lebernight & Ferree, Red Lion,	11.79
	Lister's Agri. Chem. Works, Newark, N. J.		
379	†Corn and Potato Fertilizer,	D. A. Urich, Mechanicsburg,	9.37
31		Passmore & Gillespie, Nottingham,	
594		H. G. Supplee, Bloomsburg,	
661		P. C. Steiner, Bakerstown,	
180	"G." Brand,	John E. Sheeler, Geigertown,	11.12
232	†Harvest Queen,	J. H. Oaks, Petersburg,	10.22
32		Passmore & Gillespie, Nottingham,	
390		J. N. Hersh, New Oxford,	

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
6.49	4.11	1.33	**11.93**	11.00	**10.60**	9.00	4.98	......	***4.98**	5.00	**2.64**	2.47	$32.88	$30.00	269
6.23	3.28	1.10	**10.61**	9.00	**9.51**	8.00	8.79	......	***8.79**	10.00	***1.52**	1.65	30.86	30.00	268
5.68	1.46	1.65	**8.79**	8.00	**7.14**	6.00	4.82	......	***4.82**	5.00	***1.89**	2.06	26.02	27.00	196
														29.00	773
5.31	2.91	3.99	**12.21**	12.00	***8.22**	10.00	2.23	......	**2.23**	2.00	**1.83**	1.65	25.44	25.00	201
														23.00	138
														25.00	556
5.88	2.05	.98	***8.91**	9.00	**7.93**	7.00	7.53	......	***7.53**	8.00	**.88**	.82	25.42	25.50	775
														27.00	200
														29.00	772
3.38	3.39	1.24	**8.01**	7.00	**6.77**	6.00	1.16	......	**1.16**	1.00	**.92**	.82	17.43	18.00	429
														18.00	194
														23.00	552
3.80	1.71	.94	**11.45**	12.00	**10.51**	10.00	6.52	......	**6.52**	6.50	**2.60**	2.47	34.18	35.00	555
														38.00	218
														33.00	774
.87	2.58	1.07	***8.52**	9.00	**7.45**	7.00	3.58	......	***3.58**	4.00	**1.08**	.82	21.56	22.00	195
														23.00	139
														22.00	582
.35	2.94	.84	***11.13**	11.50	**10.29**	9.25	2.04	......	**2.04**	1.85	**1.44**	.82	24.66	20.00	411
.24	3.50	2.30	**11.04**	9.00	**8.74**	8.00	3.18	......	**3.18**	3.00	**1.76**	1.65	25.78	25.00	379
														24.00	81
														27.00	594
														23.00	661
.99	1.18	1.16	**10.33**	10.00	**9.17**	8.00	4.60	......	**4.60**	4.00	**1.03**	.82	24.70	20.00	180
.31	2.05	1.96	**12.32**	11.00	**10.36**	9.00	.93	1.24	**2.17**	2.00	**1.38**	1.24	25.47	....	232
														23.00	32
														23.50	390

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*Constituent falls below guaranty.

COMPLETE FERT

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
727	Special Crop Producer,	Frank Douglass, Indiana,	8.1
389	Special Potato Fertilizer,	J. N. Hersh, New Oxford,	8.4
178	Special 10 Per Cent. Potato,	John E. Sheeler, Geigertown,	10.1
406	Standard Pure Bone Super Phosphate of Lime,	G. B. Murphy, Keys,	8.2
662	Success Fertilizer,	P. C. Steiner, Bakertown,	11.6
183	3—6—10 for Potatoes,	John E. Sheeler, Geigertown,	10.2
	Mapes Formula & Peruvian Guano Co., N. Y.		
182	Cauliflower and Cabbage Manure,	E. M. Zerr, Geigertown,	7.5
457 731	†Corn Manure,	Stewart Riley, Springville, A. F. Kimmel, Orwigsburg,	7.7
622 732	†Economical Potato Manure,	J. L. Nisley, Middletown, A. F. Kimmel, Orwigsburg,	7.4
735	Fruit and Vine Manure,	A. F. Kimmel, Orwigsburg,	8.6
244 135 621 730	†General Crop Brand,	Jones & Paxson, Hatboro, Abram Fairchild, Montandon, J. L. Nisley, Middletown, A. F. Kimmel, Orwigsburg,	9.7
136	Grain Brand,	Abram Fairchild, Montandon,	6.
181 132 620	†Potato Manure,	E. M. Zerr, Geigertown, Frank B. Rine, Lewisburg, J. L. Nisley, Middletown,	9.2
729	Root and Fruit Brand,	A. F. Kimmel, Orwigsburg,	7.8
134 728	†Top Dresser Improved,	Frank B. Rine, Lewisburg, A. F. Kimmel, Orwigsburg,	6.8
133 623	†Vegetable Manure or Complete Manure for Light Soils,	Frank B. Rine, Lewisburg, J. L. Nisley, Middletown,	6.3
	Miller Fertilizer Co., Baltimore, Md.		
288	Special Potato Fertilizer,	M. T. Harkins, Oxford,	6.06
	Nassau Fertilizer Co., New York.		
428	Common Sense Fertilizer,	P. S. Shoppel, Mohrsville,	10.61

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds. Soluble in water.	Phosphoric Acid in 100 Pounds. Reverted.	Phosphoric Acid in 100 Pounds. Insoluble.	Phosphoric Acid in 100 Pounds. Total. Found.	Phosphoric Acid in 100 Pounds. Total. Guaranteed.	Phosphoric Acid in 100 Pounds. Available. Found.	Phosphoric Acid in 100 Pounds. Available. Guaranteed.	Potash in 100 Pounds. (Water Soluble.) Present as muriate.	Potash in 100 Pounds. (Water Soluble.) Present as sulphate.	Potash in 100 Pounds. (Water Soluble.) Total. Found.	Potash in 100 Pounds. (Water Soluble.) Total. Guaranteed.	Nitrogen in 100 Pounds. Found.	Nitrogen in 100 Pounds. Guaranteed.	Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
6.65	2.13	2.35	**11.13**	9.00	**8.78**	8.00	......	1.37	**1.37**	1.00	**.95**	.82	$21.22	$20.00	727
4.28	4.01	3.68	**11.97**	......	**8.29**	......	3.24	......	**3.24**	......	**1.60**	......	25.28	25.00	389
7.35	1.69	2.28	**11.32**	9.00	**9.04**	8.00	9.70	......	***9.70**	10.00	**1.72**	1.65	32.77	27.00	178
8.05	2.41	1.95	**12.41**	11.00	**10.46**	9.00	1.73	.56	**2.29**	2.00	**2.57**	2.47	30.14	22.00	406
8.85	1.78	1.61	**12.24**	11.00	**10.63**	9.00	1.60	.49	**2.09**	2.00	**1.45**	1.24	25.71	22.00	662
7.70	1.61	1.95	**11.26**	......	**9.31**	6.00	5.07	1.04	***6.11**	10.00	***2.41**	2.47	32.22	28.00	183
1.89	3.75	2.79	**8.43**	7.00	***5.64**	6.00	7.65	......	**7.65**	6.00	**4.33**	4.12	37.11	39.00	182
1.54	5.31	4.60	**11.45**	10.00	***6.85**	8.00	6.40	......	**6.40**	6.00	**2.57**	2.47	30.82	36.00	457
														36.00	731
2.02	3.03	2.69	**7.74**	6.00	**5.05**	4.00	8.21	......	**8.21**	8.00	**3.60**	3.30	34.02	37.00	622
														36.00	732
2.55	3.48	2.17	**8.20**	7.00	**6.03**	5.00	1.73	10.12	**11.85**	10.00	**1.97**	1.65	33.91	39.00	735
2.55	5.54	3.36	**11.45**	10.00	**8.09**	8.00	2.43	......	**2.43**	2.00	**1.70**	1.65	24.30	24.00	244
														27.00	135
														27.00	621
														26.00	730
3.64	3.91	2.58	**10.13**	......	***7.55**	8.00	4.36	......	**4.36**	4.00	**1.01**	.82	22.64	27.00	136
3.09	4.39	2.81	**10.29**	8.00	**7.48**	6.00	1.20	6.19	**7.39**	6.00	**4.06**	3.71	38.92	40.00	181
														45.00	132
														40.00	620
3.74	4.50	2.62	**10.86**	......	**8.24**	......	8.39	......	**8.39**	......	**1.06**	......	27.74	31.00	729
.92	1.91	1.52	**4.35**	4.00	***2.83**	3.00	.67	1.58	**2.25**	2.00	***4.15**	4.94	27.33	32.00	134
														31.00	728
2.29	3.68	3.70	**9.67**	8.00	***5.97**	6.00	1.20	6.64	**7.84**	6.00	**5.53**	4.94	44.07	45.00	133
														42.00	623
2.40	4.23	2.61	**9.24**	8.50	***6.63**	7.00	4.52	......	***4.52**	5.00	**1.19**	.82	22.47	23.00	288
4.84	3.29	2.29	**10.42**	9.00	**8.13**	8.00	5.18	......	**5.18**	4.00	**1.87**	1.65	27.50	21.00	428

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*Constituent falls below guaranty.

COMPLETE FER

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pound
	New Jersey Agri. Chem. Co., Newark, N. J.		
491	Russell's Harvest Queen Phos. For Vegetables and Cereals,	M. C. Dietrich, Kempton,	9.
441	Russell's Spc'l Corn Manure, Corn & Similar Crops,	M. C. Dietrich, Kempton,	9.
442	Russell's Special Potato Fertilizer, Potatoes and Garden Truck,	M. C. Dietrich, Kempton,	9.
	Wm. C. Newport & Co., Philadelphia, Pa.		
92	†Fish, Bone and Potash,	Cook, Deardorff & Co., Dillsburg,	10.
614		Kopenhaver & Hoy, Millersburg,	
267	†Gilt Edge Potato and Tobacco Manure,	H. C. Worstall, Newtown,	11.1
185		J. R. Laugner, White Bear,	
159		John Penny, Dry Valley X Roads,	
550		Ogden & Allen, Canton,	
615		Kopenhaver & Hoy, Millersburg,	
668		H. L. Stultz, Duncansville,	
220	†Grain and Grass Special,	John I. Gray, Stormstown,	11.2
187		Geo. Raubenhold, Hamburg,	
154		John Penny, Dry Valley X Roads,	
94		Cook, Deardorff & Co., Dillsburg,	
479		Willis Mosier, Dushore,	
530		A. H. Ulsh, Millerstown,	
740		Frank Koenig, Orwigsburg,	
243	†Potato, Tobacco and Truck Guano,	Jones & Paxson, Hatboro,	9.21
186		J. R. Laugner, White Bear,	
155		John Penny, Dry Valley X Roads,	
93		Cook, Deardorff & Co., Dillsburg,	
480		Willis Mosier, Dushore,	
549		Ogden & Allen, Canton,	
672		H. L. Stultz, Duncansville,	
739		Frank Koenig, Orwigsburg,	
245	†Rectified Phosphate,	Jones & Paxson, Hatboro,	10.71
669		H. L. Stultz, Duncanville,	

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
3.90	4.40	7.07	**15.37**	11.00	***8.30**	9.00	2.32	......	**2.32**	1.50	***.59**	1.81	$17.12	$23.00	491
3.53	4.96	6.12	**14.61**	9.00	**8.49**	8.00	2.76	......	***2.76**	3.00	***.85**	1.65	18.31	26.00	441
3.45	4.98	6.29	**14.72**	......	**8.43**	......	3.40	......	**3.40**	......	**.73**	......	18.57	26.00	442
6.08	2.06	3.10	**11.24**	8.00	**8.14**	7.00	5.96	......	**5.96**	5.00	**1.66**	1.65	28.04	22.50	92
														22.00	614
5.22	2.32	1.75	**9.29**	9.00	***7.54**	8.00	9.13	......	***9.13**	10.00	***1.57**	1.65	29.50	30.00	267
														28.00	185
														27.00	159
														35.00	550
														25.00	615
														30.00	668
3.67	4.94	1.99	**10.60**	9.00	**8.61**	8.00	1.90	......	***1.90**	2.00	**.57**	.41	14.85	19.50	220
														15.00	137
														16.00	154
														16.25	94
														19.00	479
														17.00	530
														20.50	740
3.56	3.07	1.41	**8.04**	7.00	**6.63**	6.00	6.54	......	**6.54**	6.00	***.81**	.82	22.53	23.00	243
														23.00	186
														20.00	155
														24.00	93
														24.00	480
														25.00	549
														25.00	672
														25.00	739
4.77	1.95	1.24	***7.96**	8.00	***6.72**	7.00	5.16	......	**5.16**	5.00	**3.53**	3.30	32.13	31.00	245
														30.00	669

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.	Moisture in 100 pounds.
221	†Special Compound,	John I. Gray, Stormstown,	14.70
157		John Penny, Dry Valley X Roads,	
551		Ogden & Allen, Canton,	
560	Trucker's Joy,	Ogden & Allen, Canton,	12.88
	G. Ober & Sons, Baltimore, Md.		
396	Farmers' Mixture,	G. W. Altland, Mt. Top,	7.79
	Osceola Fertilizer Co., Osceola Mills, Pa.		
720	Ideal Mixture,	J. P. Staver, Clearfield,	4.93
	Patapsco Guano Co., Baltimore, Md.		
346	†Corn Brand Guano,	C. B. Moore, N. Lexington,	9.71
164		P. A. Baker, Vicksburg,	
522		Philip Hailey, East Salem,	
597		W. F. Slagle, Bloomsburg,	
161	Patapsco Corn and Tomato Fertilizer,	P. A. Baker, Vicksburg,	11.40
137	Patapsco Early Trucker,	Jacob Moser, Pottsgrove,	8.30
160	Patapsco Early Trucker for Quick Growth,	P. A. Baker, Vicksburg,	8.67
163	†Patapsco Sea Gull Guano,	P. A. Baker, Vicksburg,	7.50
400		Jonathan Geesey, Dallastown,	
162	Patapsco Tobacco and Potato Fertilizer,	P. A. Baker, Vicksburg,	9.46
	Pa. Amm. & Fert. Works, Harrisburg, Pa.		
375	†Capital Bone Super Phosphate,	J. H. Urich, Mechanicsburg,	6.62
534		W. F. Barnett, New Bloomfield,	
184	Dauphin Brand,	Geo. M. Dosch, White Bear,	9.23
	Piedmont-Mt. Airy Guano Co., Balto., Md.		
234	Piedmont Penna. Potato Grower,	John G. Simpson, Huntingdon,	5.44
	Pittsburg Provision Co., Pittsburg, Pa.		
638	Corn and Potato Fertilizer,	J. H. Miller, Ligonier,	2.34
635	Keystone Fertilizer,	J. H. Miller, Ligonier,	2.23
	R. H. Pollock, Baltimore, Md.		
415	†Ammoniated Bone Phosphate,	Elias Goble, Red Lion,	10.39
377		E. W. Rupp, Shiremanstown,	
624		J. L. Nisley, Middletown,	

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
5.99	2.83	2.09	*10.91	11.00	*8.82	10.00	2.28	......	2.28	2.00	1.07	1.03	$22.15	$21.00 18.00 22.00	221 157 551
4.83	1.20	2.79	*8.82	9.00	*6.03	8.00	4.63	......	*4.63	6.00	*3.58	4.12	31.80	35.00	560
7.38	2.37	2.51	12.26	11.00	9.75	9.00	2.55	......	2.55	2.00	1.19	.82	24.38	18.00	396
.71	3.57	9.29	13.57	5.00	4.28	4.00	2.84	......	*2.84	3.00	2.19	1.65	25.16	24.00	720
6.91	2.79	.66	10.36	10.00	9.70	9.00	3.20	......	3.20	3.00	*.79	.82	22.45	19.50 20.00 19.00 20.00	346 164 522 597
6.65	3.42	1.01	11.08	11.00	10.07	9.00	2.51	......	2.51	2.00	1.64	1.24	25.69	22.00	161
5.51	2.30	1.75	9.56	8.00	7.81	7.00	6.25	......	6.25	5.00	*3.94	4.12	36.34	30.00	137
5.95	2.21	1.73	9.89	8.00	8.16	7.00	6.00	......	6.00	5.00	*3.57	4.12	34.94	32.00	160
3.93	4.73	.98	9.64	9.00	8.66	8.00	1.37	......	1.37	1.00	.94	.82	19.88	19.00 18.00	163 400
5.96	2.72	1.54	10.22	9.00	8.68	8.00	4.36	......	4.36	4.00	1.99	1.65	27.56	24.00	162
6.81	4.26	1.85	12.92	11.00	11.07	9.00	3.68	......	3.68	2.00	2.65	2.47	32.32	30.00	375 534
4.11	6.22	4.09	14.42	12.00	10.33	10.00	2.32	......	2.32	2.00	*1.19	1.24	25.09	24.00	184
1.79	2.24	6.80	10.83	.....	*4.03	6.00	8.51	......	*8.51	10.00	1.77	1.65	27.87	30.00	234
.82	3.46	5.66	*9.94	11.00	*4.28	9.00	......	2.53	*2.53	3.00	*1.56	1.65	21.07	25.00	638
1.39	4.10	5.98	11.47	11.00	*5.49	9.00	.40	1.45	1.85	1.50	1.80	1.65	22.64	21.00	635
3.11	4.66	2.73	10.50	9.00	*7.77	8.00	2.17	......	2.17	2.00	1.67	1.65	23.20	24.00 21.00 24.00	415 377 624

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
677	†Special Potato and Tobacco Fertilizer,	A. M. McClure, Everett,	7.80
376		E. W. Rupp, Shiremanstown,	
277		John G. Dubbs, Bellefonte,	
692		J. A. C. Rider, Tyrone,	
749		Jerome S. Williams, Stroudsburg,	
518	†Superior Corn and Tomato Fertilizer,	H. M. Owens, Lewistown,	9.25
228		John G. Dubbs, Bellefonte,	
88		F. F. Weigard, York county,	
691		J. A. C. Rider, Tyrone,	
747		Jerome S. Williams, Stroudsburg,	
	Pugh & Sons, Oxford, Pa.		
297	Bone Phosphate,	S. R. Dickey & Co., Oxford,	8.60
	Rasin-Monumental Co., Baltimore, Md.		
401	Ammoniated Alkaline Phosphate,	G. B. Murphy, Keys,	9.64
323	Ammoniated Super Phosphate,	Barron Bros., Rockwood,	10.02
605	IXL Celebrated Universal Fertilizer,	Wm. H. Harter, Hartleton,	11.33
402	†IXL Fertilizer,	G. B. Murphy, Keys,	11.47
706		J. J. Hank, Carroltown,	
	Reading Chem. & Fert. Co., Reading, Pa.		
493	Potato and Vegetable Fertilizer,	Wm. F. Snyder, Stony Run,	8.36
	Russell Agri. Chemical Co., Newark, N. J.		
281	Ammoniated Dissolved Bone Phosphate,	C. H. Humphreys, Morrisville,	6.47
282	Special Corn Manure,	C. H. Humphreys, Morrisville,	5.23
	Schaal-Sheldon Fertilizer Co., Erie, Pa.		
811	Empire,	J. P. Lock & Co., Grove City,	8.65
809	Guano,	J. P. Lock & Co., Grove City,	10.49
810	Truckers' Manure,	J. P. Lock & Co., Grove City,	9.49
	Scientific Fertilizer Co., Pittsburg, Pa.		
109	†Scientific Bone, Meat and Potash,	Jac. M. Lohr, Davidsville,	5.90
713		W. A. Baver, Bradley Jct.,	

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
3.83	3.51	2.31	9.65	9.00	*7.34	8.00	4.52	......	4.52	4.00	1.65	1.65	$25.04	$25.00	677
														25.00	376
														30.00	227
														28.00	692
														25.00	749
3.26	5.44	1.91	10.61	9.00	8.70	8.00	2.16	......	2.16	2.00	.90	.82	20.86	21.00	518
														22.00	228
														18.50	88
														24.00	691
														20.00	747
5.89	3.23	7.35	16.47	11.00	9.12	6.00	3.14	......	*3.14	5.00	1.67	1.65	28.22	26.50	297
5.63	3.96	2.18	11.77	9.00	9.59	8.00	2.14	......	2.14	1.00	*1.25	1.65	23.65	19.00	401
5.98	3.40	1.70	11.08	9.00	9.38	8.00	1.05	......	1.05	1.00	1.40	.82	22.70	18.00	323
5.61	3.58	1.93	11.12	10.00	9.19	9.00	3.52	......	3.52	3.00	1.21	.82	24.25	19.60	605
6.06	3.59	1.79	11.44	10.00	9.65	9.00	2.43	......	*2.43	3.00	1.08	.82	23.26	19.00	402
														22.00	706
1.14	3.59	5.06	9.79	......	*4.73	7.00	2.05	......	*2.05	5.50	*.71	2.06	16.95	24.00	493
4.86	4.30	7.40	16.56	11.50	*9.16	9.50	3.22	......	3.22	2.00	1.50	1.24	27.62	32.00	281
4.90	4.37	7.35	16.62	9.00	9.27	8.00	3.37	......	3.37	3.00	*1.50	1.65	27.87	28.00	282
4.40	3.51	2.48	10.39	8.00	7.91	7.00	2.17	......	2.17	1.00	1.10	.82	21.21	22.00	811
5.10	3.24	2.30	10.64	9.00	8.34	8.00	4.08	......	4.08	4.00	1.17	.82	23.89	25.00	809
5.24	3.81	2.65	11.70	......	9.05	......	6.49	......	6.49	......	2.16	......	31.23	33.00	810
4.03	2.49	5.55	*12.07	16.00	6.52	......	.67	8.10	8.77	......	*3.17	3.30	37.42	31.00	109
														29.00	713

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
111	†Scientific Corn and Grain Fertilizer,	Jac. M. Lohr, Davidsville,	6.43
710		W. A. Baver, Bradley Jct.,	
711	Scientific Economy Fertilizer,	W. A. Baver, Bradley Jct.,	7.61
110	†Scientific Potato Fertilizer,	Jac. M. Lohr, Davidsville,	6.00
709		W. A. Baver, Bradley Jct.,	
	Scott Fertilizer Co., Elkton, Md.		
173	†Corn and Oats Grower,	J. A. Geiger, Joanna,	9.38
438		D. D. Fritch & Bro., Macungie,	
440	†Potato Grower,	D. D. Fritch & Bro., Macungie,	6.68
494		W. H. Hoffman, New Tripoli,	
171	†Potato, Truck and Tobacco Grower,	L. A. Geiger, Joanna,	7.68
738		Daniel R. Stein, Orwigsburg,	
131	Sure Growth Compound,	N. A. Eisenhauer,	12.10
130	†Sure Growth Super Phosphate,	N. A. Eisenhauer,	10.53
172		L. A. Geiger, Joanna,	
	Shenandoah Fert. Co., Shenandoah, Pa.		
420	Ringtown Clover,	D. O. Hill, Berne,	10.91
	M. L. Shoemaker & Co., Philadelphia, Pa.		
11	Swift Sure Special 10 Per Cent. Fertilizer No. 2,	Chester Co. As'n of Farmers, Kelton,	10.14
169	Swift Sure Super Phosphate for Potatoes,	J. D. Mountz, Joanna,	9.08
	Chas. A. Sickler & Bro., Wilkes-Barre, Pa.		
203	Empire Lawn Fertilizer,	Foote & Fuller, Scranton,	4.56
213	†Empire Phosphate,	Nelson Graves, Jermyn,	6.21
539		J. L. Ward, S. Towanda,	
215	†Graves Potato and Tobacco Manure,	Nelson Graves, Jermyn,	6.51
446		O. P. Beebe, Montrose,	
459	Special Manure for Potatoes and Vegetables,	A. S. Mowery, Meshoppen,	6.92
458	†Vegetable and Vine Fertilizer,	A. E. Mowery, Meshoppen,	6.07
471		J. M. Ayers, N. Towanda,	
	H. H. Smyser, York, Pa.		
397	Chicago Bone and Tankage,	H. H. Smyser, York,	6.25

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
4.43	2.64	3.82	**10.89**	9.00	***7.07**	8.00	2.40	......	**2.40**	2.00	***1.28**	1.65	$22.03	$21.00 19.00	111 710
4.82	2.91	5.68	**13.41**	10.00	***7.73**	9.00	4.64	......	**4.64**	4.00	**1.89**	1.65	28.29	23.00	711
4.29	1.94	4.84	**11.07**	10.00	***6.23**	[illegible].00	4.67	1.55	**6.22**	6.00	**2.59**	2.47	30.87	28.00 26.00	110 709
3.02	5.30	1.91	**10.23**	9.00	**8.32**	8.00	3.35	......	**3.35**	2.00	**.51**	.41	20.10	18.00 18.00	173 438
4.11	3.28	1.48	**8.87**	7.00	**7.39**	6.00	4.67	4.93	***9.60**	10.00	***1.48**	1.65	30.20	26.00 28.00	440 494
3.92	4.53	2.26	**10.71**	9.00	**8.45**	7.00	5.85	......	**5.85**	5.00	**1.78**	1.65	28.17	24.00 23.00	171 738
6.44	3.67	1.35	**11.46**	8.00	**10.11**	7.00	2.13	4.33	***6.46**	7.00	***2.84**	3.30	35.40	30.00	131
7.77	4.64	1.94	**14.35**	12.00	**12.41**	10.00	2.25	......	**2.25**	2.00	***1.51**	1.65	27.90	20.00 23.00	130 172
5.41	3.81	2.23	**11.45**	......	**9.22**	8.00	1.86	......	***1.86**	2.00	***.91**	1.65	21.51	21.00	420
5.03	2.54	4.94	**12.51**	......	***7.57**	8.00	10.88	......	**10.88**	10.00	***2.01**	2.06	34.58	25.30	11
6.40	2.37	5.97	**14.74**	11.00	**8.77**	8.00	6.91	......	**6.91**	6.50	**2.52**	2.47	34.47	31.50	169
.14	3.07	3.49	***6.70**	9.00	***3.21**	8.00	3.48	......	**3.48**	2.00	**1.72**	1.65	19.87	60.00	203
3.15	3.11	1.98	***8.24**	9.00	***6.26**	8.00	2.32	......	**2.32**	2.00	***1.57**	1.65	20.98	.... 22.00	213 539
3.44	2.13	2.66	**8.23**	......	***5.57**	6.00	4.45	......	***4.45**	5.00	**1.22**	.82	21.43	.... 30.00	215 446
1.56	2.14	3.22	***6.92**	9.00	***3.70**	8.00	6.27	......	***6.27**	6.50	***1.76**	3.30	23.43	36.00	459
2.09	2.31	3.64	**8.04**	......	***4.40**	8.00	3.39	......	***3.39**	4.00	***1.82**	2.47	21.75	33.00	458 471
5.72	1.80	3.87	**11.39**	10.00	***7.52**	8.00	1.61	......	**1.61**	1.00	**1.05**	1.03	20.89	19.00	397

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*Constituent falls below guaranty.

COMPLETE FE

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100
	Southern Fertilizer Co., York, Pa.		
413	†Ammoniated Dissolved Bone,	Lebernight & Ferree, Red Lion,	12
16		Passmore & Gillespie, Nottingham,	
663		Fletcher George, Lilly,	
733	†Farmers' Choice Brand,	A. F. Kimmel, Orwigsburg,	9.
56		C. J. Bushey, York county,	
812		D. C. Emery, Grove City,	
806	†General Crop Grower,	Sproul Bros., Boyers,	9
55		C. J. Bushey, Dillsburg,	
813		D. C. Emery, Grove City,	
	John Straining, Harrisburg, Pa.		
754	Bone and Meat Fertilizer,	John Straining, Harrisburg,	6.
	Swift & Co., Chicago, Ill.		
353	Complete Fertilizer,	H. L. Dean & Co., Addison,	9.
354	Super Phosphate,	H. L. Dean & Co., Addison,	10.
	J. M. Templin, Honeybrook, Pa.		
189	†No. 8 H. G. Potash Manure,	James Stout, Shartelsville,	6.
261		Harrison Ross, Atglen,	
	James Thomas, Williamsport, Pa.		
573	H. G. Bone Super Phosphate,	James Thomas, Williamsport,	9.6
557	†Klondyke Brand,	F. S. Manley, East Canton,	10.4
516		Levi Watt, Milroy,	
590		J. B. Smith, Washingtonville,	
572	Special Compound for Wheat, Oats, Corn and Grass,	James Thomas, Williamsport,	10.0
	I. P. Thomas & Sons Co., Philadelphia, Pa.		
481	Champion Bone Phosphate,	Wendell Lick, Dushore,	5.9
465	Improved Super Phosphate,	Sol. Choffer, Wysox,	9.8
453	Normal Bone Phosphate,	E. D. Snyder, Brooklyn,	8.7
247	†Potato Fertilizer,	Samuel Hough, Hatboro,	10.11
455		E. D. Snyder, Brooklyn,	
246	Special Truckers Fertilizer,	Samuel Hough, Hatboro,	8.74

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†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
7.29	3.02	1.28	11.59	11.20	10.31	10.00	2.74	......	2.74	2.50	1.83	1.65	$27.16	$24.00	413
														24.00	16
														26.00	663
3.25	5.20	1.43	*9.88	10.00	*8.45	9.00	2.09	......	2.09	2.00	1.00	.82	20.72	22.00	733
														18.00	56
														23.00	812
3.75	4.45	.65	*8.85	9.00	8.20	8.00	2.20	......	2.20	2.00	.58	.41	18.64	20.00	806
														17.50	55
														20.00	813
.12	1.91	1.52	3.55	.....	*2.03	2.51	.27	.35	.62	......	*1.22	1.27	12.78	15.00	754
6.10	3.25	2.07	11.42	11.00	9.35	8.00	2.25	......	2.25	1.00	1.33	1.03	23.86	21.00	353
6.83	3.52	2.00	12.35	12.00	10.35	8.00	1.78	......	*1.78	2.00	*1.49	1.65	25.14	23.00	354
6.97	3.30	2.85	13.12	12.00	*10.27	11.00	.53	7.42	*7.95	8.00	.93	.82	30.88	28.00	189
														27.00	261
5.15	3.80	1.52	*10.47	14.00	*8.95	9.00	3.05	......	3.05	2.50	2.12	2.06	26.83	28.00	573
7.09	2.18	.59	*9.86	10.00	9.27	9.00	3.25	......	3.25	3.00	.99	.82	22.81	....	557
														23.00	516
														20.00	590
5.95	4.08	.64	*10.67	11.00	10.03	9.00	3.55	......	3.55	3.00	1.24	1.03	24.81	24.00	572
7.74	2.86	2.69	13.29	12.00	10.60	10.00	.40	3.27	*3.67	4.00	2.63	1.65	32.91	26.00	481
7.73	2.75	1.39	11.87	12.00	10.48	10.00	1.84	......	1.84	1.00	1.04	.82	23.34	21.00	465
6.51	2.86	1.08	10.45	9.50	9.37	8.50	2.14	......	2.14	1.50	1.20	1.03	22.76	25.00	453
6.56	3.22	1.98	11.76	10.50	9.78	9.00	6.00	......	6.00	6.00	1.93	1.65	30.52	30.00	247
														....	455
5.18	1.72	2.14	9.04	7.00	6.90	6.00	7.53	......	7.53	6.00	*3.09	3.30	33.49	32.00	246

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.	Moisture in 100 pounds.
	Trenton Bone Fertilizer Co., Trenton, N. J.		
278	Trenton Corn Mixture,	L. A. Howells, Morrisville,	4.80
274	Trenton Corn and Truck Fertilizer,	L. A. Howells, Morrisville,	6.12
273	Excelsior,	L. A. Howells, Morrisville,	4.58
277	Trenton Potato Manure,	L. A. Howells, Morrisville,	6.05
276	Trenton Special Potato Manure,	L. A. Howells, Morrisville,	6.76
271	Trenton Super Phosphate,	L. A. Howells, Morrisville,	10.96
275	Trenton $32 Potato Manure,	L. A. Howells, Morrisville,	6.38
272	Trenton XX Brand Fertilizer,	L. A. Howells, Morrisville,	5.53
	Walker, Stratman & Co., Pittsburg, Pa.		
836	Potato Special,	A. O. Hunter & Sons, Crawf's Cor's,	7.00
	W. E. Whann, William Penn, Pa.		
521	Chester Valley Raw Bone Super Phosphate,	Francis Hower, Mifflintown,	7.13
	Windle, Doan & Co., Coatesville, Pa.		
262	Potato Phosphate,	Jos. Morrell, Parkesburg,	10.54
	The R. A. Wooldridge Co., Baltimore, Md.		
18 239	†Champion Giant Phosphate,	Passmore & Gillespie, Sylmar, A. B. Hearn, Gorsuch,	12.95
223	Triumph,	Andrew Harter, Coburn,	9.75
341 17 404	†Triumph Pure Bone Phosphate,	N. E. Bitner, Kimmel, Passmore & Gillespie, Sylmar, G. B. Murphy, Keys,	10.28
	York Chemical Works, York, Pa.		
66	Dempwolf's Corn and Oats Special Fertilizer,	Geo. W. Dick, York county,	12.51
79	Dempwolf's Half and Half Fertilizer,	J. H. Little, Idaville,	9.00
575	Dempwolf's Potato and Truck Special Fertilizer,	A. T. Baird, Lock Haven,	7.29
574	Special Tobacco Fertilizer,	A. T. Baird, Lock Haven,	6.44
53	Dempwolf's Standard Fertilizer,	A. J. Wierman, Dillsburg,	13.28
	Henry S. Zook, Elverson, Pa.		
168 511	†No. 5 Pride of Chester Corn, Oats and Wheat Phos.,	Jos. M. Jackson, Joanna, Henry S. Zook, Geigertown,	10.02

†Composite sample.

LIZERS—Continued.

Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds. (Water Soluble.)				Nitrogen in 100 Pounds.		Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
			Total.		Available.				Total.						
Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
1.00	3.30	4.73	**9.03**	......	***4.30**	8.00	4.94	......	***4.94**	7.00	**2.42**	1.65	$[illegible]6.00	$26.00	278
1.79	5.31	6.50	**13.60**	......	***7.10**	10.00	6.37	......	**6.37**	5.00	**3.64**	2.47	36.34	35.00	274
2.34	5.67	2.65	**10.66**	......	**8.01**	8.00	2.59	......	**2.59**	2.00	**.83**	.82	20.62	19.00	273
4.06	3.40	2.35	**9.81**	......	**7.46**	7.00	7.66	......	**7.66**	3.00	**1.73**	1.65	28.80	25.00	277
4.49	2.49	2.80	**9.78**	......	***6.98**	9.00	9.95	......	***9.95**	10.00	**3.39**	3.30	37.46	32.00	276
6.10	2.64	3.09	**11.83**	......	***8.74**	11.00	3.66	......	**3.66**	3.00	***2.41**	2.47	29.30	27.00	271
4.66	2.17	2.15	**8.98**	......	***6.83**	9.00	10.14	......	**10.14**	10.00	**2.68**	2.47	34.44	31.00	275
2.64	4.06	4.64	**11.34**	......	***6.70**	9.00	3.52	......	**3.52**	2.00	**1.80**	.82	24.90	21.00	272
4.46	1.80	4.63	**10.89**	10.00	***6.26**	8.00	4.93	1.26	**6.19**	6.00	**2.54**	2.47	30.57	25.00	836
5.26	4.55	5.05	**14.86**	11.00	**9.81**	8.00	2.63	......	***2.63**	3.00	***1.96**	1.99	28.47	....	521
5.52	6.36	2.95	**14.83**	......	**11.88**	......	3.80	......	**3.80**	......	**.87**	......	20.53	28.00	262
6.98	2.79	.87	**10.64**	......	**9.77**	9.00	2.24	......	**2.24**	2.00	**.91**	.82	22.09	19.00	18
														....	239
4.91	3.17	1.27	**9.35**	......	**8.08**	8.00	4.28	......	**4.28**	4.00	**1.25**	1.24	23.68	24.00	223
5.36	2.80	1.16	**9.32**	......	**8.16**	8.00	1.73	2.63	**4.36**	4.00	**1.45**	1.24	25.06	22.50	341
														24.00	17
														20.50	404
5.85	2.77	.76	***9.38**	10.00	**8.62**	8.00	5.22	......	**5.22**	5.00	***1.44**	1.65	25.86	21.00	66
1.14	5.84	1.60	**8.58**	8.00	***6.98**	7.00	1.20	......	**1.20**	1.00	***.63**	.82	16.68	17.00	79
4.16	4.60	2.43	**11.19**	10.00	**8.76**	8.00	1.20	5.34	***6.54**	7.00	***2.19**	2.47	31.88	30.60	575
5.64	2.20	.93	**8.77**	8.00	**7.84**	7.00	......	9.05	***9.05**	10.00	***2.56**	3.30	34.71	38.60	574
5.33	4.37	1.31	**11.01**	11.00	**9.70**	9.00	1.33	......	***1.33**	2.00	***1.65**	2.47	24.07	22.00	53
4.00	4.20	3.07	**11.27**	11.00	***8.20**	10.00	2.21	......	**2.21**	2.00	**.56**	.41	15.33	18.00	168
														18.00	511

*Constituent falls below guaranty.

ROCK AND POTAS

Furnishing Phosphori

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	The American Agri. Chemical Co., N. Y.	
65	Gem Alkaline Phosphate,	O. F. Arnold, York county,
	Bradley Branch, New York.	
331	†Bradley's Alkaline Bone with Potash,	Peter Fink, Somerset,
299		A. F. Stutzman, Johnstown,
462		Daniel Hurley, Wysox,
	Canton Chemical Branch, Baltimore, Md.	
667	†Canton Chemical Soluble Bone and Potash,	Skyles, Miller & Co., Martinsburg,
412		Lebernight & Ferree, Red Lion,
337		Jas. D. Miller, Rockwood,
686		H. F. Gump, Everett,
762		W. B. Wivey, Middleburg,
	Clark's Cove Branch, New York.	
490	Clark's Cove Super Phosphate with Potash,	P. W. Hunsinger, Dushore,
	Detrick Branch, Baltimore, Md.	
764	†Detrick's Gem Alkaline Phosphate,	Stenninger Bros., Middleburg,
768		Wm. M. Atkinson, McVeytown,
15	†Detrick's Soluble Bone Phosphate and Potash,	Passmore & Gillespie, Sylmar,
520		Jas. McCully, Mifflintown,
217	Detrick's Soluble Bone and Phosphate Fertilizer,	W. T. Hoover, Port Matilda,
	Great Eastern Branch, Rutland, Vt.	
425	†G. E. Soluble Bone and Potash,	A. L. Stetzler, Shoemakersville,
328		J. M. Miller, Bills,
254		William Jones, Kelton,
464		—— ——, Wysox Station,
484		Jos. Yorkon, Dushore,
817		J. B. Atwell, Big Bend,
	Lazaretto Guano Branch, Baltimore Md.	
339	†Lazaretto Dissolved Bone and Potash,	Walker Bros., Glade,
689		J. E. Taylor, Mann's Choice,

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†Composite sample.

FERTILIZERS.

Acid and Potash.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
				Total.		Available.				Total.				
	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
12.40	4.46	4.16	.46	**9.08**	7.00	**8.62**	6.00	3.14	....	**3.14**	3.00	$13.52	$14.00	65
10.46	6.55	4.58	1.76	**12.89**	11.00	**11.13**	10.00	2.11	....	**2.11**	2.00	14.66	16.00 16.00 15.00	331 299 462
11.74	5.95	5.58	1.07	**12.60**	11.00	**11.53**	10.00	2.33	....	**2.33**	2.00	14.83	18.75 15.00 16.00 17.00 15.00	667 412 337 686 762
10.10	4.89	5.69	2.27	**12.85**	....	**10.58**	....	2.41	....	**2.41**	....	21.67	18.00	495
9.07	4.93	2.80	.71	**8.41**	....	**7.73**	....	3.30	....	**3.30**	....	13.27	14.00	764
8.96	3.94	6.44	1.14	**11.52**	11.00	**10.38**	10.00	2.26	....	**2.26**	2.00	13.81	12.00 13.50 15.00	768 15 520
10.99	2.94	7.41	1.69	**12.04**	11.00	**10.35**	10.00	2.09	....	**2.09**	2.00	13.72	17.00	217
9.84	4.15	5.94	1.74	**11.83**	11.00	**10.09**	10.00	2.57	....	**2.57**	2.00	14.20	14.00 14.00 16.00 .... 17.00 18.00	425 328 254 464 484 817
11.04	3.41	8.68	1.42	**13.51**	11.00	**12.09**	10.00	3.55	....	**3.55**	2.00	16.20	18.00 13.65	339 689

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
106	†Lazaretto H. G. Dissolved Bone and Potash, ...	Aaron F. Swank, Davidsville, ...
73		D. B. Meyers, Gardeners Station, ...
460		Daniel Hurley, Wysox, ...
	Milsom Branch, East Buffalo, N. Y.	
421	†Milsom's Dissolved Bone and Potash, ...	Jacob Hollenbach, Hamburg, ...
784		J. B. Miller, Wesley, ...
	Moro-Philips Branch, Philadelphia, Pa.	
225	Moro-Philips' Gem, ...	John H. Weber, Oak Hall, ...
	Packers Union Branch, Rutland, Vt.	
78	†Packers Union Banner Wheat Grower, ...	D. B. Meyers, Gardeners Station, ...
687		A. C. Richards, Mann's Choice, ...
	Quinnipiac Branch, New York.	
60	Quinnipiac Dissolved Bone and Potash, ...	Paxton Flour and Feed Co., Bowmansdale,
	Reese Branch, Baltimore, Md.	
744	Reeses' H. G. Potash Mixture, ...	W. S. Weaver, Easton, ...
496	Reeses' Wheat Special, ...	Wm. H. Reitz, Lynport, ...
	Susquehanna Branch, Baltimore, Md.	
96	†Susquehanna Alkaline Bone Phosphate, ...	James Lean & Son, Dillsburg, ...
2		Jos. Brown, Kelton, ...
543		A. B. Cranmer, Monroeton, ...
563		G. J. Garnhart, Dewart, ...
579	Susquehanna Grain and Grass Producer, ...	J. N. Getz, Lock Haven, ...
619	Susquehanna H. G. Bone Phosphate, ...	W. A. Bailits, Dauphin, ...
564	†Susquehanna H. G. Bone and Potash, ...	G. J. Garnhart, Dewart, ...
578		J. N. Getz, Lock Haven, ...
	Tygert-Allen Branch, Philadelphia, Pa.	
351	Tygert-Allen's Alkaline Bone Phosphate, ...	R. S. McMillen, Kingwood, ...
439	Tygert-Allen's Star Soluble Bone and Potash, ...	J. Singwaster & Co., Macungie, ...
	Zell Branch, Baltimore, Md.	
77	Zell's Dissolved Bone Phosphate and Potash, ...	D. B. Meyers, Gardners Sta., ...

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†Composite sample.

FERTILIZERS—Continued.

	Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.						
				Total.		Available.				Total.				
Moisture in 100 pounds.	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
11.20	9.65	3.51	.83	**13.99**	11.00	**13.16**	10.00	4.09	....	**4.09**	2.00	$17.95	$18.00	106
													18.00	73
													18.00	460
7.82	5.89	5.33	2.27	**13.49**	11.00	**11.22**	10.00	1.15	....	***1.15**	2.00	13.86	14.00	421
													18.00	784
11.77	3.95	4.49	.61	**9.05**	....	**8.44**	....	3.01	....	**3.01**	....	13.22	14.50	225
10.38	1.34	8.93	2.13	**12.40**	11.00	**10.27**	10.00	2.11	....	**2.11**	2.00	13.65	14.00	78
													13.65	687
13.12	7.34	5.26	.51	**13.11**	11.00	**12.60**	10.00	2.35	....	**2.35**	2.00	15.43	14.50	69
10.61	4.34	6.83	1.76	***12.93**	13.00	***11.17**	12.00	5.21	....	**5.21**	5.00	17.59	20.00	744
7.98	1.40	7.60	2.06	**11.06**	11.00	***9.00**	10.00	2.21	....	**2.21**	2.00	12.96	16.00	496
11.75	1.72	9.07	1.49	**12.28**	11.00	**10.79**	10.00	2.17	....	**2.17**	2.00	13.83	16.00	96
													14.00	2
													16.00	543
													15.00	563
12.75	9.33	2.85	.26	**12.44**	....	**12.18**	....	3.10	....	**3.10**	....	16.11	27.00	579
11.27	9.00	2.90	.22	***12.12**	13.00	***11.90**	12.00	6.92	....	**6.92**	5.00	19.74	23.00	619
10.33	9.40	3.20	.22	***12.82**	13.00	**12.60**	12.00	5.38	....	**5.38**	5.00	18.67	20.00	564
													29.00	578
11.81	9.05	2.72	.63	**12.40**	11.00	**11.77**	10.00	2.10	....	**2.10**	2.00	14.92	15.00	351
8.52	1.09	7.70	2.24	**11.03**	11.00	***8.79**	10.00	2.08	....	**2.08**	2.00	12.78	15.50	439
11.40	3.65	7.27	1.55	**12.47**	12.00	***10.92**	11.00	2.14	....	**2.14**	2.00	14.14	14.00	77

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	The Armour Fert. Works, Chicago, Ill.	
125	†Phosphate and Potash No. 2,	J. W. Painter & Co., Red Top,
26		Passmore & Gillespie, Nottingham,
382		D. E. Brown, East Berlin,
	R. S. Aucker, Shamokin, Pa.	
628	Economy Potash Phosphate,	Geo. R. Hendricks, Selinsgrove,
	Baltimore Pulverizing Co., Baltimore, Md.	
761	Penniman's Excelsior Fertilizer,	A. M. Carpenter, Beavertown,
	Baugh & Sons Co., Philadelphia, Pa.	
90	Soluble Alkaline Super Phosphate,	S. N. Bailey & Bro., Dillsburg,
	Bowker Fertilizer Co., Boston, Mass.	
452	†Empire State Bone and Potash,	P. H. Taylor, Wysox Sta.,
825		J. H. Sheffer, Sligo,
312	Wheat Grower,	A. Hostetler, Geistown,
	Henry Cope & Co., Lincoln University, Pa.	
33	Soluble Bone and Potash,	Passmore & Gillespie, Nottingham,
	Josiah Cope & Co., Lincoln University, Pa.	
290	†Soluble Bone and Potash,	Josiah Cope & Co., Oxford,
426		C. S. Dreibelbeis, Shoemakersville,
	Eureka Fertilizer Co., Perryville, Md.	
409	†Alkaline Bone and Potash,	F. H. Shenberger, Brownton,
284		Lewis H. Kirk & Co., Nottingham,
524		Dimm & Kiser, Thompsontown,
526		Dimm & Kiser, Thompsontown,
	W. S. Farmer & Co., Baltimore, Md.	
602	B. & P. Phosphate,	Bogar & Bingaman, Herndon,
	Griffith & Boyd, Baltimore, Md.	
148	†XX Potash Manure,	Jacob Hummel, Red Top,
84		W. A. Storner, Storners Sta.,
	Hanover Fertilizer Co., Baltimore, Md.	
384	Dissolved Bone Phosphate,	H. F. Stambaugh, Abbottstown,

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†Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.		Present as muriate.	Present as sulphate.	Total.				
				Found.	Guaranteed.	Found.	Guaranteed.			Found.	Guaranteed.			
12.30	7.00	1.59	.31	***8.90**	10.00	**8.59**	8.00	4.61	....	*4.61	5.00	$15.20	$18.00	125
													16.50	26
													18.00	382
7.74	3.63	5.59	.88	**10.10**	9.00	**9.22**	8.00	3.82	....	**3.82**	2.00	14.58	16.50	628
9.60	2.16	7.90	1.34	**11.40**	....	**10.06**	10.00	2.84	....	**2.84**	2.50	14.08	15.65	761
7.75	3.11	7.07	4.12	**14.30**	....	**10.18**	10.00	2.16	....	**2.16**	2.00	14.56	16.00	90
6.07	2.19	5.73	2.71	**10.63**	9.00	***7.92**	8.00	3.09	....	**3.09**	3.00	13.58	17.00	452
													21.00	825
12.45	4.35	5.05	2.84	**12.24**	11.00	***9.40**	10.00	2.56	....	**2.56**	1.00	14.26	14.50	312
10.69	2.14	5.87	.51	***8.52**	12.00	***8.01**	10.00	3.73	....	**3.73**	2.00	13.47	16.50	33
9.01	4.75	6.31	.96	**12.02**	....	**11.06**	10.00	2.16	....	**2.16**	2.00	14.14	14.00	290
													14.00	426
9.29	7.39	3.24	2.74	**13.37**	12.00	**10.63**	10.00	2.59	....	**2.59**	2.00	15.31	16.00	409
													13.50	284
													14.00	524
													19.00	526
13.46	9.47	2.52	.20	**12.19**	11.00	**11.99**	10.00	2.31	....	**2.31**	2.00	15.16	15.00	602
12.46	6.70	3.76	1.12	**11.58**	11.00	**10.46**	10.00	5.33	....	**5.33**	5.00	17.36	18.00	148
12.91	5.91	4.42	.99	**11.32**	11.00	**10.33**	10.00	5.34	....	**5.34**	5.00	17.11	17.00	84
10.12	1.64	7.06	2.00	**10.70**	....	**8.70**	....	2.34	....	**2.34**	....	12.94	14.00	384

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
236	H. G. Bone and Potash,	Isenberg Milling Co., Huntingdon,
115	†Royal Bone and Potash,	Josiah Specht, Kantner,
231		E. M. Soope, Petersburg,
	M. P. Hubbard & Co., Baltimore, Md.	
50	Soluble Bone and Potash for Wheat and Grass,	E. A. Keasy, Dillsburg,
	Jarecki Chemical Co., Sandusky, O.	
650	Dissolved Bone with Potash,	S. J. Saint, Sharpsburg,
	Lackawanna Chem. & Fert. Co., Moosic, Pa.	
430	†Alkaline Bone,	Henry G. Stamm, Leesport,
199		R. J. Fairfield, Doleville,
554		S. W. Lyons & Son, Canton,
777		Miles Mattern, Scotia,
	Lister's Agri. Chem. Works, Newark, N. J.	
179	Alkaline Bone,	John E. Sheeler, Geigertown,
	Nassau Fertilizer Co., New York.	
470	Nassau Grain and Grass Fertilizer,	Farmers Club, Orwell,
427	†Potash and Phosphate,	P. S. Shappel, Mohrsville,
444		Irwin Plott, Meyersburg,
	Patapsco Guano Co., Baltimore, Md.	
347	†Baltimore Soluble Phosphate,	C. B. Moore, N. Lexington,
391		J. N. Hurst, New Oxford,
	Pa. Amm. & Fert. Works, Harrisburg, Pa.	
64	Soluble Bone and Potash,	O. F. Arnold, York county,
	Piedmont-Mt. Airy Guano Co., Balto., Md.	
235	Piedmont Special Potash Mixture,	John G. Simpson, Huntingdon,
	Pittsburg Provision Co., Pittsburg, Pa.	
637	Phosphate and Potash,	J. H. Miller, Ligonier,

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†Composite sample.

ERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds. Soluble in water.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash in 100 Pounds. Present as muriate.	Present as sulphate.	Total. Found.	Total. Guaranteed.	Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
0.33	4.15	5.00	1 48	***10.63**	11.00	***9.15**	10.00	4.56	……..	**4.56**	4.00	$15.57	$18.00	236
11.05	1.89	7.31	1.54	**10.74**	10.00	**9.20**	9.00	2.03	……..	**2.03**	1.00	12.80	16.00	115
													16.00	231
13.31	7.78	3.34	.56	**11.68**	……..	**11.12**	10.00	2.02	……..	**2.02**	2.00	14.28	15.00	50
9.44	7.15	4.87	3.68	**15.70**	13.00	**12.02**	12.00	.80	2.13	***2.93**	3.00	17.19	23.00	650
9.20	5.61	2.83	1.00	***9.44**	10.00	**8.44**	8.00	1.80	……..	**1.80**	1.62	12.34	14.00	430
													15.00	199
													17.50	554
													15.00	777
11.78	9.01	1.37	.67	**11.05**	……..	**10.38**	10.00	1.20	1.51	**2.71**	2.00	14.98	15.00	179
10.88	5.27	5.47	2.45	**13.19**	11.00	**10.74**	10.00	2.26	……..	**2.26**	2.00	14.67	12.15	470
9.74	2.59	7.04	2.55	**12.18**	11.00	***9.63**	10.00	5.10	……..	**5.10**	5.00	16.64	17.00	427
													14.40	444
12.26	8.34	3.39	.55	**12.28**	12.00	**11.73**	11.00	2.42	……..	**2.42**	2.00	15.10	14.50	347
													18.00	391
11.25	1.28	7.46	2.48	**11.22**	11.00	***8.74**	10.00	2.72	……..	**2.72**	2.00	13.46	16.00	64
8.60	3.08	5.59	2.19	**10.86**	…….	***8.67**	10.00	4.87	……..	***4.87**	5.00	15.69	20.00	235
7.18	.56	5.88	4.93	**11.37**	10.00	***6.44**	9.00	2.33	……..	**2.33**	2.00	12.50	18.00	637

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	R. H. Pollock, Baltimore, Md.	
626	†Victor Bone Phosphate,	J. L. Nisley, Middletown,
517		H. M. Owens, Lewistown,
378		E. W. Rupp, Shiremanstown,
676		A. M. McClure, Everett,
748		Jerome S. Williams, Stroudsburg,
	Rasin-Monumental Co., Baltimore, Md.	
119	Bone and Potash Fertilizer,	Barron Bros., Rockwood,
705	Special Formula for Corn and Buckwheat,	J. J. Hank, Carroltown,
	Scientific Fertilizer Co., Pittsburg, Pa.	
712	Scientific Bone and Potash Fertilizer,	W. A. Baver, Bradley Junction,
708	Scientific Phosphate and Potash,	W. A. Baver, Bradley Junction,
	Scott Fertilizer Co., Elkton, Md.	
129	†Tip Top and Potash,	N. A. Eisenhauer, Kelly Point,
737		Daniel R. Stein, Orwigsburg,
	H. H. Smyser, York, Pa.	
398	Chicago Crop Grower,	H. H. Smyser, York,
	James Thomas, Williamsport, Pa.	
558	†Dissolved Florida Bone and Potash Phosphate,	F. S. Manley, East Canton,
515		Levi Watt, Milroy,
571		James Thomas, Williamsport,
822	Florida Bone and Potash,	Amos Meyers, Sligo,
	I. P. Thomas & Sons Co., Philadelphia, Pa.	
454	†Special Corn Fertilizer,	E. D. Snyder, Brooklyn,
68		D. F. Stitzwell, York county,
466		Sol. Choffer, Wysox,
140	†Special Alkaline Bone,	W. H. Mack, Pottsgrove,
67		D. F. Stitzwell, York county,
482		Wendell Lick, Dushore,
	The R. A. Wooldridge Co., Baltimore, Md.	
20	†German Potash Mixture,	Passmore & Gillespie, Sylmar,
533		J. L. Ritter & Son, Newport,

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†Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 24.)	Selling price at the point of selection.	Sample number.
				Total.		Available.				Total.				
	Soluble in water.	**Reverted.**	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
10.82	1.79	7.64	1.37	**10.80**	10.00	**9.43**	9.00	1.89	....	**1.89**	1.00	$12.73	$15.00	626
													17.00	517
													13.00	378
													15.00	676
													16.00	748
11.43	6.93	4.11	1.75	**12.79**	11.50	**11.04**	10.00	2.29	....	**2.29**	2.00	14.85	15.50	119
14.04	1.45	6.04	1.58	**9.07**	7.50	**7.49**	6.00	3.06	....	**3.06**	3.00	12.75	15.00	705
10.99	7.36	3.31	1.42	**12.09**	11.00	**10.67**	10.00	4.69	....	***4.69**	6.00	17.00	20.00	712
9.51	5.08	3.99	2.37	**11.44**	11.00	***9.07**	10.00	2.08	....	**2.08**	2.00	13.47	16.00	708
11.58	9.05	5.32	.98	**15.35**	13.00	**14.37**	11.00	2.33	....	**2.33**	2.00	16.86	15.25	129
													14.00	737
7.87	3.17	5.54	5.19	**13.90**	12.00	***8.71**	10.00	2.33	....	**2.33**	2.00	14.28	15.00	398
11.53	6.60	5.18	.88	**12.66**	12.00	**11.78**	11.00	2.32	....	**2.32**	2.00	14.94	....	558
													17.50	515
													15.00	571
12.88	8.16	3.78	.63	**12.57**	12.00	**11.94**	11.00	2.14	....	**2.14**	2.00	14.96	20.00	824
14.42	2.62	7.17	2.20	***11.99**	12.00	***9.79**	10.00	4.80	2.08	**6.88**	6.50	18.81	....	454
													20.00	68
													....	466
14.74	3.14	6.81	2.44	**12.39**	12.00	***9.95**	10.00	4.48	....	**4.48**	4.00	16.23	18.00	140
													18.00	67
													18.00	482
12.74	5.27	5.85	1.05	**12.17**	....	**11.12**	10.00	2.18	....	**2.18**	2.00	15.52	13.50	20
													....	533

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
224	Liberty Bell,	Andrew Harter, Coburn,
340	†Liberty Bell Potash Mixture,	W. E. Bitner, Kimmel,
249		Franklin G. Evans, Kelton,
640		J. Lambert, Lambertsville,
699		Geo. Huntley, Ebensburg,
	York Chemical Works, York, Pa.	
81	Dempwolf's Black Cross Fertilizer,	J. H. Little, Garners Sta.,
87	Dempwolf's Red Cross Fertilizer,	N. H. Spangler, Rossville,
69	Dempwolf's Red Cross Phosphate and Potash,	Amos F. Bushey, York county,
80	Dempwolf's Wheat Special,	J. H. Little, Idaville,

†Composite sample.

ERTILIZERS—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Computed commercial value at Department rating. (See p. 24.)	Selling price at the point of selection.	Sample number.
				Total.		Available.				Total.				
	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.			
3.41	9.42	3.10	.28	**12.80**	....	**12.52**	12.00	2.97	....	***2.97**	3.00	$16.15	$20.00	224
12.44	9.56	2.96	.28	**12.80**	....	**12.52**	12.00	3.16	....	**3.16**	3.00	16.38	17.50	340
													17.00	249
													17.50	640
													20.00	699
10.77	.98	8.49	2.45	**11.92**	11.00	***9.47**	10.00	2.39	....	**2.39**	2.00	13.52	15.00	81
11.86	4.34	6.17	1.81	**12.32**	11.00	**10.51**	10.00	5.10	....	**5.10**	5.00	17.08	16.00	87
12.48	4.95	5.57	1.71	**12.23**	11.00	**10.52**	10.00	4.99	....	***4.99**	5.00	17.04	18.00	69
11.56	1.12	8.92	1.20	**11.24**	11.00	**10.04**	10.00	1.74	....	***1.74**	2.00	12.79	15.00	80

*Constituent falls below guaranty.

DISSOLVED BON

Furnishing Phosphori

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	Bowker Fertilizer Co., Boston, Mass.	
188	O. I. O. Phosphate,	F. L. Wagner, Upper Berne,
	Pittsburg Provision Co., Pittsburg, Pa.	
636	Guano Fertilizer,	J. H. Miller, Ligonier,

ERTILIZERS.

cid and Nitrogen.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Nitrogen in 100 Pounds.		Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.						
				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
12.96	4.78	4.88	4.53	**14.19**	11.00	***9.66**	10.00	**.71**	.50	$15.19	$15.00	188
2.69	.51	4.01	7.20	**11.72**	11.00	***4.52**	9.00	**2.02**	1.65	19.50	18.00	636

*Constituent falls below guaranty.

GROUND BON

Furnishing Phosphor

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	American Agri. Chemical Co., New York.	
673	Pure Ground Bone,	H. L. Stultz, Duncansville,
	Bradley Branch, New York.	
719	Bradley's Fine Ground Bone,	Punxsutawney H'dware Co., Punxsutawne
	American Reduction Co., Pittsburg, Pa.	
367	Fine Ground Bone,	Eicher & Graft, Scottdale,
	Armour's Fertilizer Works, Chicago, Ill.	
683	†Bone Meal,	John S. Hershberger, Everett,
726		Frank Douglass, Indiana,
532	†Bone Meal,	J. L. Ritter & Son, Newport,
567		S. G. Updegraff, Williamsport,
	Baugh & Sons Co., Philadelphia, Pa.	
37	Bone Meal,	J. Watson Croft, Ambler,
326	Bone Meal,	C. H. Schmucker, Freidens,
319	Ground Raw Bone,	Jacob Stattler, Elton,
	The Berg Co., Philadelphia, Pa.	
431	Raw Bone Fine,	S. S. Bagentose, Leesport,
	A. H. Blaker & Co. Fox Chase, Pa.	
255	Raw Bone Meal,	J. Patterson Ramsey, Kelton,
	Bowker Fertilizer Co., Boston, Mass.	
304	†Bone Meal,	R. L. Watts, Scalp Level,
307		A. Hostetler, Geistown,
586	Bowker's Bone,	Bailey & Blair, Wellsboro,
	Cambria Fertilizer Co., Johnstown, Pa.	
665	†Pure Fine Ground Bone Dust,	Herman Neafer, Altoona,
698		H. A. Shoemaker, Ebensburg,
	Washington Ewing, Landenberg, Pa.	
25	Pure Ground Raw Bone,	Passmore & Gillespie, Nottingham,
	S. M. Hess & Bro., Philadelphia, Pa.	
510	Fine Ground Bone,	John Brown, Mantz,

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†Composite sample.

ERTILIZERS.

Acid and Nitrogen.

Moisture in 100 pounds.	Mechanical Analysis.		Chemical Analysis.				Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
	Diameter less than 1-50 inch. "fine." Per cent.	Diameter greater than 1-50 inch, "coarse." Per cent.	Phosphoric Acid.		Nitrogen.				
			Found.	Guaranteed.	Found.	Guaranteed.			
6.67	54	46	**22.13**	20.60	**3.83**	3.30	$27.25	$30.00	673
5.14	67	33	**26.26**	....	**2.45**	....	27.15	29.00	719
4.18	89	11	***20.85**	23.00	**4.24**	3.30	28.94	28.00	367
4.26	83	17	**24.24**	24.00	**3.31**	2.47	28.62	28.00 28.00	683 726
9.21	86	14	***23.90**	24.00	**2.47**	2.47	26.31	.... 30.00	532 567
8.14	71	29	**22.71**	21.50	**3.75**	3.50	28.12	29.00	37
9.47	90	10	**21.59**	21.50	**4.01**	3.50	28.87	....	326
6.93	53	47	**21.63**	....	**4.06**	....	27.34	26.00	319
11.64	43	57	**21.63**	20.00	**4.04**	3.30	26.90	32.00	431
6.04	55	45	**23.14**	....	**3.66**	....	27.46	27.00	255
2.24	70	30	**26.03**	20.00	**1.77**	1.50	25.40	28.00 25.00	304 307
2.40	75	25	**29.45**	....	**1.72**	....	27.82	35.00	586
6.15	61	39	**22.24**	20.00	**3.89**	3.00	27.75	30.00 28.00	665 698
8.78	37	63	**21.88**	18.00	**4.02**	2.47	26.67	28.00	25
4.19	72	28	**22.20**	....	**3.15**	....	26.32	28.00	510

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	Lackawanna Fert. & Chem. Co., Moosic, Pa.	
198	†Pure Ground Bone,	R. J. Tanfield, Daleville,
776		Miles Mattern, Scotia,
553	Warranted Pure Ground Bone,	S. W. Lyons, Canton,
	Mapes Formula & Peruvian Guano Co., N. Y.	
746	Pure Ground Bone,	R. F. Schwarz, Analomink,
	Newport, Wm. C., & Co., Philadelphia, Pa.	
257	Bone Meal,	W. S. Hastings & Son, Atglen,
	Pittsburg Provision Co., Pittsburg, Pa.	
633	Crescent Butchers Ground Bone,	J. H. Miller, Ligonier,
634	Pure Raw Bone Meal,	J. H. Miller, Ligonier,
	R. H. Pollock, Baltimore, Md.	
625	†Ground Animal Bone,	J. L. Nisley, Middletown,
675		A. M. McClure, Everett,
414	Soft Ground Bone,	Elias Gable, Red Lion,
	Pugh & Lyons, Oxford, Pa.	
298	Ground Raw Bone,	S. R. Dickey & Co., Oxford,
	Russell Agricul. Chem. Co., Newark, N. J.	
280	Ground Bone,	C. H. Humphreys, Morrisville,
	Scientific Fertilizer Co., Pittsburg, Pa.	
108	†Pure Raw Bone Meal,	Jac. M. Lohr, Davidsville,
714		W. A. Baver, Bradley Jct.,
	Trenton Bone Fertilizer Co., Trenton, N. J.	
279	Trenton Pure Fine Ground Bone,	L. A. Howells, Morrisville,
	Windle, Doan & Co., Coatesville, Pa.	
264	Pure Ground Bone,	Jos. Worrall, Parkesburg,
	The R. A. Wooldridge Fert. Co., Balti., Md.	
250	Truckers Bone Meal,	Franklin Evans, Kelton,

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†Composite sample.

FERTILIZERS—Continued.

Moisture in 100 pounds.	Mechanical Analysis.		Chemical Analysis.				Computed commercial value of 2,000 pounds at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
	Diameter less than 1-50 inch, "fine." Per cent.	Diameter greater than 1-50 inch, "coarse." Per cent.	Phosphoric Acid.		Nitrogen.				
			Found.	Guaranteed.	Found.	Guaranteed.			
8.87	71	29	***22.42**	23.00	**3.92**	3.71	$28.24	$27.00 28.00	198 776
5.50	56	44	**23.41**	23.00	**4.14**	3.71	28.88	35.00	553
6.65	67	33	**23.15**	....	**3.96**	....	28.76	36.00	746
4.16	82	18	***20.32**	22.90	**3.91**	3.30	27.34	25.00	257
3.07	83	17	**18.09**	16.00	**2.98**	2.47	23.54	24.00	633
4.20	89	11	***20.28**	22.00	**4.32**	4.12	28.69	25.00	634
5.87	63	37	**20.37**	....	**3.42**	....	25.33	30.00 28.00	625 675
2.80	84	16	**20.42**	14.00	***1.81**	2.47	22.11	29.00	414
7.02	51	49	**22.10**	20.00	**4.08**	3.30	27.68	26.50	298
4.77	63	37	***22.81**	23.00	**3.03**	2.88	26.11	32.00	280
7.27	71	29	**23.05**	22.00	***3.26**	3.30	27.12	27.00 25.00	108 714
3.46	87	13	**21.30**	19.00	**3.67**	3.30	27.63	29.00	279
6.83	48	52	**21.10**	....	**3.95**	....	26.53	30.00	264
4.90	72	28	**15.62**	13.74	**2.55**	2.47	20.31	24.00	250

*Constituent falls below guaranty.

ACIDULATE

Furnishi

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	American Agricultural Chem. Co., N. Y.	
405	Orchilla Guano,	G. B. Murphy, Keys,
	Bradley Branch, New York.	
801	†Bradley's Dissolved Bone,	E. H. Adams, Wick,
461		Daniel Hurley, Wysox,
804		E. H. Adams, Wick,
716	Bradley's Soluble Dissolved Bone,	Punxsutawney H'dware Co., Punxsutawney
	Canton Chemical Branch, Baltimore, Md.	
685	†Canton Chemical Baker's Dissolved Bone Phos.,	H. F. Gump, Everett,
355		T. J. Jacobs, Somerfield,
127		J. H. Wingert, Lewisburg,
693		H. L. Orr, Tyrone,
745		W. S. Weaver, Easton,
336	†Canton Chemical Baker's Dissolved S. C. Bone,	Jas. D. Miller, Rockwood,
763		W. B. Winey, Middleburg,
	Crocker Branch, Buffalo, N. Y.	
419	Crocker's Dissolved Bone Phosphate,	John A. Loose, Berne,
	Cumberland Branch, New York.	
512	Cumberland Dissolved Bone Phosphate,	Warren Fretz, Geigertown,
	Detrick Branch, Baltimore, Md.	
19	†Detrick's Dissolved S. C. Bone,	Passmore & Gillespie, Sylmar,
428		J. S. Fobst, Emaus,
	Great Eastern Branch, Rutland, Vt.	
483	G. E. Dissolved Bone,	Joseph Yorkon, Dushore Sta.,
	Lazaretto Guano Branch, Baltimore, Md.	
688	Lazaretto Dissolved Bone Phosphate, 14 Per Cent.,	I. E. Taylor, Manns Choice,

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†Composite sample.

ROCK PHOSPHATES.

Phosphoric Acid.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 24.)	Selling price at the point of selection.	Sample number.
	Soluble in water	Reverted.	Insoluble.	Total.		Available.				
				Found.	Guaranteed.	Found.	Guaranteed.			
9.00	0.00	4.26	13.06	**17.32**	....	**4.26**	....	$10.46	$16.00	405
8.31	10.29	3.53	1.54	**15.36**	15.00	***13.82**	14.00	13.28	18.00	801
									13.00	461
									23.00	804
8.30	11.79	3.60	2.90	**18.29**	15.00	**15.39**	14.00	14.90	13.00	716
8.44	11.19	4.06	.69	**15.94**	15.00	**15.25**	14.00	13.95	14.00	685
									15.00	355
									12.00	127
									14.00	693
									14.00	745
9.64	11.83	3.74	.60	**16.17**	15.00	**15.57**	14.00	14.17	15.00	336
									14.00	763
7.05	9.81	4.98	.59	**15.38**	15.00	**14.79**	14.00	12.47	13.00	419
7.85	8.85	5.78	3.12	**17.75**	15.00	**14.63**	14.00	14.17	14.00	512
7.59	10.12	4.82	.60	**15.54**	15.00	**14.94**	14.00	13.60	12.00	19
									15.00	433
6.71	12.01	4.60	.55	**17.16**	15.00	**16.61**	14.00	14.80	15.00	483
10.82	11.19	4.10	.65	**15.94**	15.00	**15.29**	14.00	13.96	12.60	688

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample was Taken.
	Milsom Branch, East Buffalo, New York.	
363	†Milsom's Dissolved Bone Phosphate,	King Bros., Uniontown,
150		Peter Haus, New Columbia,
75		D. B. Myers, Gardeners Sta.,
670		H. L. Stultz, Duncansville,
771		Wm. M. Atkinson, McVeytown,
	Moro-Philips Branch, Philadelphia, Pa.	
226	†Moro-Philips Soluble Bone,	John H. Weber, Oak Hall,
593		H. G. Supplee, Bloomsburg,
506	†Moro-Philips Soluble Bone Phosphate, 14 Per Cent.,	N. E. Hunsicker, Mantz,
600		Lemuel Campbell, Sunbury,
765		Ewing & Kinsloe, Newton Hamilton,
	Packers Union Branch, Rutland, Vt.	
342	†Packers Union Acidulated Bone,	J. G. Miller, Kimmel,
86		J. W. Gladfelter, Rossville,
535		J. H. Kirk, East Waterford,
473	Packers Union Wheat, Oats and Clover,	James Avery, Dushore Sta.,
	Sharpless & Carpenter Branch, Phila., Pa.	
175	S. & C's Acid Phosphate,	L. A. Geiger, Joanna,
	Tygert-Allen Branch, Philadelphia, Pa.	
107	Tygert-Allen's Star Dissolved Bone Phosphate,	A. F. Swank, Davidsville,
	Wheeler Branch, Rutland, Vt.	
463	†Wheeler's Electrical Dissolved Bone,	H. W. Choffer, Potterville,
702		John S. Wetsell, Carroltown,
253	†Wheeler's Unammoniated Wheat Grower,	J. A. Wiley, Kelton,
701		John S. Wetsell, Carroltown,
	Williams & Clark Branch, New York.	
143	†Williams & Clark' Acorn Acid Phos., 14 Per Cent.,	F. W. Lindner, Pottsgrove,
205		John Lee, Scranton,

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†Composite sample,

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
				Total.		Available.				
	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.			
9.27	8.68	4.26	2.01	**14.95**	13.00	**12.94**	12.00	$12.74	$13.00	363
									13.00	150
									12.00	75
									13.50	670
									12.50	771
11.36	11.16	4.23	.84	**16.23**	15.00	**15.39**	14.00	14.10	13.50	226
									14.00	593
7.55	9.96	5.01	1.17	**16.14**	....	**14.97**	....	13.80	13.50	506
									15.00	600
									13.15	765
10.50	12.03	3.99	.63	**16.65**	15.00	**16.02**	14.00	14.49	13.50	342
									12.50	86
									14.00	535
6.05	9.64	3.99	1.58	**15.21**	13.00	**13.63**	12.00	13.11	....	473
12.25	10.44	4.40	.22	**15.06**	15.00	**14.84**	14.00	13.44	12.00	175
8.96	12.22	3.07	.83	**16.12**	15.00	**15.29**	14.00	14.13	13.00	107
9.37	12.03	4.03	.71	**16.77**	15.00	**16.06**	14.00	14.53	14.00	463
									14.00	702
8.84	9.24	4.36	.95	**14.55**	13.00	**13.60**	12.00	12.82	12.00	253
									16.00	701
11.07	10.79	2.83	.66	***14.28**	15.00	***13.62**	14.00	12.93	12.00	143
									....	205

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	Zell Branch, Baltimore, Md.	
233	Zell's Dissolved Bone,	W. S. Hastings, Alexandria,
76	†Zell's Dissolved Bone Phosphate,	D. B. Myers, Gardners Sta.,
369		L. C. Fox, N. Stanton,
	Armour Fertilizer Works, Chicago, Ill.	
613	†Cereal Phosphate Fertilizer,	J. A. Romberger, Elizabethville,
566		S. G. Updegraff, Williamsport,
680		J. S. Hershberger, Everett,
612	†Star Phosphate,	J. A. Romberger, Elizabethville,
28		Passmore & Gillespie, Nottingham,
681		J. S. Hershberger, Everett,
	Baugh & Sons Co., Philadelphia, Pa.	
104	†H. G. Acid Phosphate,	P. I. Blough, Hooversville,
91		S. N. Bailey & Bro., Dillsburg,
266		Brinton Walter, Parkesburg,
332		Peter Fink, Somerset,
	A. H. Blaker & Co., Fox Chase, Pa.	
13	Acid Phosphate,	Patterson Ramsey, Kelton,
	Bowker Fertilizer Co., Boston, Mass.	
313	†Dissolved Bone Phosphate,	A. Hostetler, Geistown,
366		Loucks & Morrow, Scottdale,
585		Bailey & Blair, Wellsboro,
829		James McGuire, Knox,
	Henry Cope & Co., Lincoln University, Pa.	
295	Acid Phosphate,	Henry Cope & Co., Oxford,
	Josiah Cope & Co., Lincoln University, Pa.	
291	Acidulated Phosphate,	Josiah Cope & Co., Oxford,
	Eureka Fertilizer Co., Perryville, Md.	
283	†P. P. Super Phosphate,	Lewis H. Kirk & Co., Oxford,
527		Dimm & Kiser, Thompsontown,

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†Composite sample

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
				Total.		Available.				
	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.			
4.10	10.08	5.29	1.43	**16.80**	15.00	**15.37**	14.00	$14.16	13.00	233
8.88	11.03	3.32	1.52	**15.87**	15.00	**14.35**	14.00	13.68	13.00	76
									16.50	369
8.15	8.41	3.51	.77	**12.69**	12.00	**11.92**	10.00	11.64	11.50	613
									14.00	566
									13.00	680
10.19	13.14	.98	.24	***14.36**	16.00	**14.12**	14.00	13.34	12.00	612
									12.00	28
									14.00	681
8.17	9.95	6.18	1.43	**17.56**	....	**16.13**	14.00	14.59	15.00	104
									14.00	91
									12.50	266
									14.00	332
9.82	8.75	4.98	1.07	**14.80**	....	***13.73**	14.00	12.88	12.00	13
6.60	1.66	8.14	5.33	**15.13**	12.00	***9.80**	11.00	11.22	13.00	313
									17.00	366
									18.00	585
									18.00	829
9.62	10.25	4.11	1.52	**15.88**	15.00	**14.36**	14.00	13.60	11.50	295
9.76	10.67	4.88	.43	**15.98**	....	**15.55**	14.00	13.98	11.50	291
8.66	6.58	5.23	2.75	***14.56**	16.00	***11.81**	14.00	12.07	12.00	283
									12.50	527

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*Constituent falls below guaranty.

ACIDULATED ROCK

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	W. S. Farmer & Co., Baltimore, Md.	
601	Dissolved S. C. Bone,	Bogar & Bingaman, Herndon,
	Griffith & Boyd, Baltimore, Md.	
300	H. G. Acid Phosphate,	David B. Wertz, Johnstown,
167	†Original Super Phosphate,	Adam Krug, Allenwood,
83		W. A. Storner, Storners Sta.,
659		P. C. Steiner, Bakerstown,
	Hanover Fertilizer Co., Baltimore, Md.	
387	Dissolved S. C. Rock,	H. F. Stambaugh, Abbottstown,
238	Dissolved S. C. Rock,	Isenberg Milling Co., Huntingdon,
	S. M. Hess & Bro., Philadelphia, Pa.	
507	H. G. Acid Phosphate,	John Brown, Mantz,
814	Soluble Bone,	J. N. Williamson, Harrisville,
	Jarecki Chemical Co., Sandusky, O.	
648	Dissolved Bone-Black Wheat Special,	S. J. Saint, Sharpsburg,
	Lackawanna Fert. & Chem. Co., Moosic, Pa.	
197	Acid Phosphate,	R. J. Tanfield, Daleville,
	Nassau Fertilizer Co., New York.	
443	Nassau Soluble Bone Phosphate,	Irwin Platt, Meyersburg,
	Wm. C. Newport Co., Philadelphia, Pa.	
477	†Clear Acid Phosphate,	Willis Mosier, Dushore,
156		John Penny, Dry Valley X Roads,
529		A. H. Ulsh, Millerstown,
	Patapsco Guano Co., Baltimore, Md.	
595	Battle-Axe Phosphate,	W. F. Slagle,
523	Patapsco Dissolved S. C. Bone,	Philip Harley, E. Salem,
392	Patapsco Pure Dissolved S. C. Bone,	J. N. Hersh, New Oxford,
	R. H. Pollock, Baltimore, Md.	
674	†Dissolved S. C. Bone,	A. M. McClure, Everett,
690		J. A. C. Rider, Tyrone,

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†Composite sample.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.				
				Found.	Guaranteed.	Found.	Guaranteed.			
8.97	8.90	5.55	1.93	**16.38**	15.00	**14.45**	14.00	$13.65	$14.00	601
11.46	11.10	3.26	1.66	**16.02**	15.00	**14.36**	14.00	13.75	13.00	300
8.15	7.85	4.90	2.91	**15.66**	13.00	**12.75**	12.00	12.84	13.00	167
									12.50	83
									14.00	659
11.83	9.22	4.74	2.07	**16.03**	....	**13.96**	....	13.46	13.00	387
13.26	9.29	4.13	1.79	**15.21**	....	***13.42**	14.00	13.00	14.00	238
7.70	11.32	4.37	1.21	**16.90**	15.00	**15.69**	14.00	14.42	13.50	507
10.06	11.79	3.39	1.89	**17.07**	15.00	**15.18**	14.00	14.41	18.00	814
14.03	10.59	4.68	1.10	**16.37**	16.00	**15.27**	15.00	14.02	20.00	648
10.22	12.38	1.92	.15	***14.45**	15.00	**14.30**	14.00	13.33	15.00	197
9.57	12.27	4.20	1.03	**17.50**	15.00	**16.47**	14.00	14.92	11.15	443
11.29	10.60	4.71	2.54	**17.85**	15.00	**15.31**	14.00	14.58	15.00	477
									13.00	156
									13.00	529
7.96	2.18	9.98	1.89	**14.05**	13.00	**12.16**	12.00	11.44	13.00	595
9.87	11.72	4.04	.49	**16.25**	15.00	**15.76**	14.00	14.24	13.00	523
1.71	11.66	4.51	1.03	**17.20**	15.00	**16.17**	14.00	14.67	14.50	392
11.74	9.39	4.53	1.71	**15.63**	15.00	***13.92**	14.00	13.32	13.00	671
									14.00	690

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*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	Rasin-Monumental Co., Baltimore, Md.	
403	†Acid Phosphate,	G. B. Murphy, Keys,
118		Barron Bros., Rockwood,
704		J. J. Hank, Carroltown,
703	Sea Wall,	J. J. Hank, Carroltown,
117	Sea Wall Special,	Barron Bros., Rockwood,
	Reading Chem. & Fert. Co., Reading, Pa.	
492	Reading Star,	Wm. F. Snyder, Stony Run,
	Scientific Fertilizer Co., Pittsburg, Pa.	
707	Scientific Dissolved Bone,	W. A. Baver, Bradley Jct.,
	Scott Fertilizer Co., Elkton, Md.	
736	Tip Top Soluble Bone,	Daniel R. Stein, Orwigsburg,
	M. L. Shoemaker & Co., Philadelphia, Pa.	
9	Dissolved Bone and Potash,	Chester Co. Ass'n of Farmers, Kelton,
	Chas. A. Sickler & Bro., Wilkes-Barre, Pa.	
214	Monarch Phosphate,	Nelson Graves, Jermyn,
	H. H. Smyser, York, Pa.	
399	Chicago Soluble Bone,	H. H. Smyser, York,
	Southern Fertilizer Co., York, Pa.	
57	†Dissolved Bone Phosphate,	C. J. Bushey,
734		A. F. Kimmel, Orwigsburg,
	J. M. Templin, Honeybrook, Pa.	
260	H. G. Acid Phosphate,	Harrison Ross, Atglen,
	James Thomas, Williamsport, Pa.	
589	†Dissolved Florida Bone Phosphate,	Cotner & Diehl,
559		T. S. Manley, East Canton,
700		J. S. Wetsell, Carroltown,
	York Chemical Works, York, Pa.	
54	Dempwolf's Dissolved Phosphate Fertilizer,	A. J. Wierman, Dillsburg,
	Henry S. Zook, Elverson, Pa.	
258	No. 4 Clear Acid Phosphate,	Amos Smoker, Atglen,

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†Composite sample.

PHOSPHATES—Continued.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
	Soluble in water.	Reverted.	Insoluble.	Total.		Available.				
				Found.	Guaranteed.	Found.	Guaranteed.			
8.46	11.60	3.55	2.55	17.70	15.00	15.15	14.00	$14.61	$12.50 14.25 13.50	403 118 704
11.70	9.86	3.63	1.85	15.34	11.50	13.49	10.00	13.16	12.00	703
10.38	10.33	3.31	2.03	15.67	11.50	13.64	10.00	13.35	13.00	117
5.50	1.42	5.10	4.26	10.78	7.00	6.52	5.50	8.84	15.00	492
5.62	6.49	4.88	1.88	13.25	13.00	*11.37	12.00	11.49	13.00	707
10.71	11.60	5.98	.79	18.37	16.00	17.58	14.00	15.42	13.00	736
5.99	1.94	8.44	6.05	16.43	....	10.38	....	11.86	14.30	9
6.27	3.37	7.70	1.58	12.65	....	*11.07	14.00	10.81	....	214
8.12	12.06	2.71	3.38	18.15	15.00	14.77	14.00	14.72	12.50	399
10.65	10.98	4.73	.64	16.35	15.00	15.71	14.00	14.18	12.25 14.00	57 731
9.92	9.37	4.52	.99	*14.88	15.00	*13.89	14.00	13.03	12.00	260
11.29	12.18	3.76	.46	16.40	15.00	15.94	14.00	14.41	14.00 .... 14.00	589 559 700
8.45	1.85	12.35	2.79	16.99	15.00	14.20	14.00	12.96	12.50	54
10.80	9.48	4.75	2.86	17.09	15.00	14.23	14.00	13.93	12.00	258

*Constituent falls below guaranty.

Sample number.	Manufacturer and Brand.	From Whom Sample Was Taken.
	The American Agricultural Chem. Co., N. Y.	
211	Muriate of Potash, ...	David White, Tompkinsville, ...
	Bowker Fertilizer Co., Boston, Mass.	
305	Muriate of Potash, ...	R. L. Watts, Scalp Level, ...
	Hubbard Fertilizer Co., Baltimore, Md.	
778	Muriate of Potash, ...	—— ——, Centre Furnace, ...
	Jacob Reese, Philadelphia, Pa.	
100	*Odorless Slag Phosphate, ...	Henry Stahl, Hooversville, ...
	M. L. Shoemaker, & Co., Philadelphia, Pa.	
8	Nitrate of Soda, ...	Chester Co. Ass'n of Farmers, Kelton, ...

†Composite sample.

ERTILIZERS.

Moisture in 100 pounds.	Phosphoric Acid in 100 Pounds.							Potash in 100 Pounds.				Nitrogen in 100 lbs.		Computed commercial value at Department rating. (See p. 24.)	Selling price of 2,000 pounds at the point of selection.	Sample number.
				Total.		Available.				Total.						
	Soluble in water.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Present as muriate.	Present as sulphate.	Found.	Guaranteed.	Found.	Guaranteed.			
.12	......	......	......	......	......	......	......	49.80	......	***49.80**	50.00	......	......	52.80	......	211
.85	......	......	......	......	......	......	......	51.62	......	**51.62**	......	......	......	54.63	$40.00	305
2.19	......	......	......	......	......	......	......	50.65	......	**50.65**	......	......	......	53.66	......	778
.48	0.00	6.18	10.69	***16.87**	19.03	......	......	......	......	......	......	......	......	......	16.00	100
1.13	......	......	......	......	......	......	......	......	......	......	......	**15.52**	......	54.08	44.30	8

*Constituent falls below guaranty.

*The phosphoric acid in basic slag is combined in a manner different from that in either dissolved or raw ock or bone; the slag phosphate is chiefly tetra-calcium phosphate. This is much more available to lants than the results of solution by water and ammonium citrate indicate.

LIST

OF

FERTILIZER MANUFACTURERS

WHO TOOK OUT

Licenses for the Sale of Commercial Fertilizers

IN

PENNSYLVANIA IN 1902,

TOGETHER WITH A LIST OF THE

VARIOUS LICENSED BRANDS OFFERED FOR SALE.

BRANDS OF FERTILIZERS LICENSED FOR SALE IN PENNSYLVANIA FOR THE YEAR 1902.

THE ABBOTT & MARTIN RENDERING CO., No. 232 N. High Street, Columbus, Ohio.

1. "Ideal Grain Grower."
2. "Peerless Bone and Potash."
3. "Harvest King."
4. "Abbott's Tobacco and Potato Special."
5. "New York Special."
6. "Standard Phosphate."
7. "Star Phosphate."
8. "Benders Bone Meal."

ALLEGHENY CITY FERTILIZER WORKS, Allegheny, Pa.

1. "Pure Raw Bone Phosphate."
2. "Pure Raw Bone Meal."
3. "Potato Manure."
4. "Banner Phosphate."
5. "Dissolved Bone and Potash."
6. "Odorless Lawn and Garden Plant Food."
7. "Full Value Phosphate."
8. "Butcher's Bone Meal."
9. "Bone Meal."
10. "Grain and Grass Phosphate."
11. "Special Potash and Phosphate."
12. "Acid Phosphate."

THE ALLENTOWN MANUFACTURING CO., Allentown, Pa.

1. "High Grade Truck and Garden Phosphate."
2. "High Grade Potato Phosphate."
3. "Complete Bone Phosphate."
4. "Special $25.00 Phosphate."
5. "Phosphate and Potash."
6. "Pure Ground Bone."
7. "Acidulated Phosphate."
8. "Economical Phosphate."
9. "Pure Bone and Meal."

AMERICAN REDUCTION CO., No. 1942 Forbes Street, Pittsburg, Pa.

1. "Pittsburg Guano."
2. "Iron City."
3. "Common Sense."
4. "Vegetable Manure."
5. "Fine Ground Bone."

THE AMERICAN AGRICULTURAL CHEMICAL CO., No. 326 Broadway, New York, N. Y.

1. "Pure Ground Bone."
2. "Fine Ground Bone."
3. "Bone Meal."
4. "Muriate of Potash."
5. "Genuine German Kainit."
6. "Dissolved Animal Bone."
7. "Gem Alkaline Bone."

THE A. A. C. CO., BRADLEY'S BRANCH, P. O. Box 217, New York, N. Y.

1. "Bradley's Dissolved Bone and Potash."
2. "Bradley's Bean and Potato Phosphate."
3. "Bradley's Soluble Dissolved Bone."
4. "Bradley's Niagara Phosphate."
5. "Bradley's Alkaline Bone with Potash."
6. "Bradley's B. D. Sea Fowl Guano."

THE A. A. C. CO., CANTON CHEMICAL BRANCH, P. O. Box 407, Baltimore, Md.

1. "Canton-Chemical C. C. C. Special Compound."
2. "Canton-Chemical Baker's Standard H. G. Guano."
3. "Canton-Chemical Baker's Fish Guano."
4. "Canton-Chemical Potato Manure."
5. "Canton-Chemical B. G. Ammoniated Bone."
6. "Canton-Chemical Resurgam Guano."
7. "Canton-Chemical Baker's Special Wheat, Corn and Grass Mixture."
8. "Canton-Chemical Harrow Brand Crop Grower."
9. "Canton-Chemical Eagle Phosphate."
10. "Canton-Chemical Soluble Alkaline Bone."
11. "Canton-Chemical Soluble Bone and Potash."
12. "Canton-Chemical Baker's Dissolved Bone Phosphate."
13. "Canton-Chemical Baker's Dissolved S. C. Bone."

THE A. A. C. CO., CHICOPEE GUANO BRANCH, No. 88 Wall Street, New York, N. Y.

1. "Chicopee Farmer's Reliable."
2. "Chicopee Standard Guano."

THE A. A. C. CO., CLARK'S COVE BRANCH, P. O. Box 1779, New York, N. Y.

1. "Clark's Cove Atlas Bone Phosphate."
2. "Clark's Cove Triumph Bone and Potash."
3. "Clark's Cove Defiance Complete Manure."
4. "Clark's Cove King Philip Alkaline Guano."
5. "Clark's Cove Potato and Hop Grower."

THE A. A. C. CO., CROCKER BRANCH, Buffalo, N. Y.

1. "Crocker's General Crop Grower."
2. "Crocker's Universal Grain Grower."
3. "Crocker's Complete Manure."
4. "Crocker's Complete New Rival Fertilizer."

5. "Crocker's Wheat and Corn Fertilizer."
6. "Crocker's Potato, Hop and Tobacco Fertilizer."
7. "Crocker's Ammoniated Bone Super-Phosphate."
8. "Crocker's Dissolved Bone and Potash."
9. "Crocker's Dissolved Bone Phosphate."

THE A. A. C. CO., CUMBERLAND BRANCH, No. 27 William Street, New York, N. Y.

1. "Cumberland Dissolved Bone Phosphate."
2. "Cumberland Bone and Potash."
3. "Cumberland Hawkeye Fertilizer."

THE A. A. C. CO., DETRICK BRANCH, No. 26 Chamber of Commerce, Baltimore, Md.

1. "Detrick's Quickstep Bone Phosphate for Potatoes and Tobacco."
2. "Detrick's Kangaroo Komplete Kompound."
3. "Detrick's Royal Crop Grower."
4. "Detrick's Standard Potash Fertilizer."
5. "Detrick's Corn and Oats Fertilizer."
6. "Detrick's Imperial Compound."
7. "Detrick's Paragon Ammoniated Bone Phosphate and Potash."
8. "Detrick's P. & B. Special Fertilizer."
9. "Detrick's Bone and Potash (16x4) Mixture."
10. "Detrick's Soluble Bone Phosphate and Potash."
11. "Detrick's Dissolved S. C. Bone."
12. "Orchilla Guano."

THE A. A. C. CO., GREAT EASTERN BRANCH, Rutland, Vt.

1. "Great Eastern Northern Corn Special."
2. "Great Eastern Vegetable, Vine and Tobacco."
3. "Great Eastern Wheat Special."
4. "Great Eastern General."
5. "Great Eastern English Wheat Grower."
6. "Great Eastern Soluble Bone and Potash."
7. "Great Eastern Dissolved Bone."
8. "Great Eastern Unammoniated Wheat Special."
9. "Great Eastern High Grade Cabbage Grower."

THE A. A. C. CO., LAZARETTO GUANO BRANCH, Merchant's Bank Building, Baltimore, Md.

1. "Lazaretto Crop Grower."
2. "Lazaretto Bone Compound."
3. "Lazaretto Special Potato Fertilizer."
4. "Lazaretto Ammoniated Bone Phosphate."
5. "Lazaretto Excelsior A. A. A."
6. "Lazaretto Dissolved Bone and Potash."
7. "Lazaretto Dissolved Bone Phosphate."
8. "Lazaretto H. G. Dissolved Bone and Potash."

THE A. A. C. CO., MARYLAND BRANCH, No. 30 S. Holliday Street, Baltimore, Md.

1. "Maryland Ammoniated Bone."
2. "Maryland O. K. Ammoniated Fertilizer."
3. "Maryland Alkaline Bone."
4. "Maryland Linden Super-Phosphate."
5. "Maryland Bono Super-Phosphate."
6. "Maryland Dissolved S. C. Phosphate."
7. "Maryland Compound for Potatoes and Tobacco."

THE A. A. C. CO., MICHIGAN CARBON WORKS BRANCH, Detroit, Mich.

1. "Red Line Phosphate."
2. "Red Line Phosphate with Potash."
3. "Red Line Complete Manure."
4. "General Crop Fertilizer."
5. "Homestead "A" Bone Black Fertilizer."

THE A. A. C. CO., MILSOM BRANCH, East Buffalo, N. Y.

1. "Milsom's Erie King Fertilizer."
2. "Milsom's Wheat, Oats and Barley Fertilizer."
3. "Milsom's Buffalo Guano."
4. "Milsom's Buffalo Fertilizer."
5. "Milsom's Potato, Hop and Tobacco Fertilizer."
6. "Milsom's Corn Fertilizer."
7. "Milsom's Vegetable Bone Fertilizer."
8. "Milsom's Dissolved Bone and Potash."
9. "Milsom's Acid Phosphate."
10. "Milsom's Dissolved Bone Phosphate."

THE A. A. C. CO., MORO-PHILLIPS BRANCH, No. 708 The Bourse, Philadelphia, Pa.

1. "Moro-Phillips Pure Phuine."
2. "Moro-Phillips Soluble Bone Phosphate."
3. "Moro-Phillips Wheat Special."
4. "Moro-Phillips Farmers' Phosphate."
5. "Moro-Phillips Farmers' Potato Mixture."
6. "Moro-Phillips Alkaline Bone Phosphate."
7. "Moro-Phillips Special Fertilizer."
8. "Moro-Phillips C. & G. Complete Fertilizer."
9. "Moro-Phillips Standard Guano."

THE A. A. C. CO., NIAGARA BRANCH, P. O. Box 189, Buffalo, N. Y.

1. "Niagara Grain and Grass Grower."
2. "Niagara Wheat and Corn Producer."
3. "Niagara Dissolved Bone and Potash."
4. "Niagara Dissolved Bone Phosphate."

THE A. A. C. CO., PACIFIC GUANO BRANCH, P. O. Box 2350, New York, N. Y.

1. "Pacific Dissolved Bone Phosphate."
2. "Pacific Dissolved Bone and Potash."

3. "Pacific A. No. 1 Phosphate."
4. "Pacific Nobsque Guano."
5. "Pacific Potato Phosphate."

THE A. A. C. CO., PACKERS UNION BRANCH, Rutland, Vt.

1. "Packers Union Gardeners' Complete Manure."
2. "Packers Union Animal Corn Fertilizer."
3. "Packers Union Potato Manure."
4. "Packers Union Universal Fertilizer."
5. "Packers Union American Wheat and Rye Grower."
6. "Packers Union Banner Wheat Grower."
7. "Packers Union Acidulated Bone."
8. "Packers Union Wheat, Oats and Clover."

THE A. A. C. CO., QUINNIPIAC BRANCH, No. 27 William Street, New York, N. Y.

1. "Quinnipiac Soluble Dissolved Bone."
2. "Quinnipiac Dissolved Bone and Potash."
3. "Quinnipiac Mohawk Fertilizer."
4. "Quinnipiac Climax Phosphate."

THE A. A. C. CO., READ BRANCH, No. 88 Wall Street, New York, N. Y.

1. "Read's Standard Super-Phosphate."
2. "Read's Leader Blood and Bone."
3. "Read's Farmers' Friend Super-Phosphate."
4. "Read's Acid Phosphate (14 Per Cent.)."
5. "Read's Bone and Potash."

THE A. A. C. CO., REESE BRANCH, Equitable Building, Baltimore, Md.

1. "Reese's Standard."
2. "Reese's Potato Phosphate."
3. "Reese's Mayflower."
4. "Reese's Potato Manure."
5. "Reese's Ammoniated Bone Phosphate Mixture."
6. "Reese's Harvest Queen."
7. "Reese's Pilgrim Fertilizer."
8. "Reese's Challenge Crop Grower."
9. "Reese's Half and Half."
10. "Reese's High Grade Potash Mixture, 12x5."
11. "Reese's Crown Phosphate and Potash."
12. "Reese's Grass and Grain."
13. "Reese's Wheat Special."
14. "Reese's Dissolved Phosphate of Lime."
15. "Reese's Elm Phosphate."

THE A. A. C. CO., SHARPLESS & CARPENTER BRANCH, No. 124 S. Delaware Avenue, Philadelphia, Pa.

1. "Sharpless & Carpenter Corn and Truck Guano."
2. "Sharpless & Carpenter Farmers' Imp. Potato Manure."
3. "Sharpless & Carpenter Gilt Edge Potato and Tobacco Manure."
4. "Sharpless & Carpenter No. 1 Bone Phosphate."

5. "Sharpless & Carpenter Royal Spring Mixture."
6. "Sharpless & Carpenter Soluble Bone and Potash."
7. "Sharpless & Carpenter Farmers' Bone Phosphate."
8. "Sharpless & Carpenter Dis. Bone Phos. for Potatoes and General Use."
9. "Sharpless & Carpenter No. 2 for Grain and Grass."
10. "Sharpless & Carpenter Soluble Tampico Guano."
11. "Sharpless & Carpenter Acid Phosphate."

THE A. A. C. CO., STANDARD BRANCH, No. 40 Exchange Place, New York, N. Y.

1. "Standard Dissolved Bone Phosphate."
2. "Standard Bone and Potash."
3. "Standard "A" Fertilizer."
4. "Standard Guano."

THE A. A. C. CO., SUSQUEHANNA BRANCH, Cor. South and Water Streets, Baltimore, Md.

1. "Susquehanna Potato Phosphate."
2. "Susquehanna Pure Bone Phosphate."
3. "Susquehanna Ammoniated Bone Phosphate."
4. "Susquehanna XXV Phosphate."
5. "Susquehanna Crop Grower."
6. "Susquehanna High Grade Bone and Potash."
7. "Susquehanna Alkaline Bone Phosphate."
8. "Susquehanna Superior Rock Phosphate."
9. "Susquehanna Soluble Bone Phosphate."

THE A. A. C. CO., TYGERT-ALLEN BRANCH, No. 708 The Bourse, Philadelphia, Pa.

1. "Tygert-Allen Star Guano."
2. "Tygert-Allen Star Potato Grower."
3. "Tygert-Allen Star Dissolved Bone Phosphate."
4. "Tygert-Allen Star Soluble Bone and Potash."
5. "Tygert-Allen Star Bone Phosphate."
6. "Tygert-Allen Standard Bone Phosphate."
7. "Howitz's Acid Phosphate."
8. "Allen's Popular Phosphate."
9. "Allen's Special Brand Potato Manure."
10. "Allen's Special for Wheat and Grass."
11. "Allen's Nitro Phosphate."
12. "Allen's Alkaline Bone Phosphate."
13. "Yearsley's Philadelphia Standard Phosphate."

THE A. A. C. CO., M. E. WHEELER & CO. BRANCH, Rutland, Vt.

1. "Wheeler's Corn Fertilizer."
2. "Wheeler's Potato Manure."
3. "Wheeler's Superior Truck."
4. "Wheeler's Royal Wheat Grower."
5. "Wheeler's Wheat and Clover Fertilizer."
6. "Wheeler's Electrical Dissolved Bone."
7. "Wheeler's Unammoniated Wheat Grower."

THE A. A. C. CO., WILLIAMS & CLARK BRANCH, No. 27 William Street, New York, N. Y.

1. "Williams & Clark Acorn Acid Phosphate."
2. "Williams & Clark Dissolved Bone and Potash."
3. "Williams & Clark Prolific Fertilizer."
4. "Williams & Clark Royal Bone Phosphate."
5. "Williams & Clark Americus High Grade Special."
6. "Williams & Clark Americus Universal Ammoniated Dis. Bone."
7. "Williams & Clark Good Grower Potato Phosphate."

THE A. A. C. CO., ZELL GUANO BRANCH, No. 32 South Street, Baltimore, Md.

1. "Zell's Special Compound for Potatoes and Vegetables."
2. "Zell's Ammoniated Bone Super-Phosphate."
3. "Zell's Hustler Phosphate."
4. "Zell's Economizer Phosphate."
5. "Zell's Little Giant."
6. "Zell's Dissolved Bone Phosphate and Potash."
7. "Zell's Electric Phosphate."
8. "Zell's Dissolved Bone Phosphate."

ANSTINE, A., Stewartstown, Pa.

1. "Bone Phosphate."

THE ARMOUR FERTILIZER WORKS, No. 205 LaSalle Street, Chicago, Ill.

1. "Bone Meal."
2. "Raw Bone Meal."
3. "Phosphate and Potash."
4. "Wheat, Corn and Oats Special."
5. "Ammoniated Bone and Potash."
6. "Fruit and Root Crop Special."
7. "All Soluble."
8. "Bone, Blood and Potash."
9. "Armour's Royal Amm. Bone."
10. "High Grade Potash."
11. "Grain Grower."
12. "Star Phosphate."
13. "Cereal Phosphate."
14. "Phosphate and Potash No. 2."
15. "Armour's Wheat Special."
16. "Special Mixture."

AUCKER, R. S., Shamokin, Pa.

1. "Bone Meal."
2. "Bone Meal with Potash."
3. "High Grade Bone and S. H. Phosphate."
4. "Grade A. Bone and Slaughter House Phosphate."
5. "Grade B. Bone and Slaughter House Phosphate."
6. "Grade D. Bone and Slaughter House Phosphate."
7. "Grade E. Bone and Slaughter House Phosphate."
8. "Economy Potash Phosphate."
9. "High Grade Acid Phosphate."

BALTIMORE PULVERIZING COMPANY, Nos. 13 and 15 North Street, Baltimore, Md.

1. "Penniman's Excelsior Fertilizer."
2. "Farmer's Favorite Fertilizer."
3. "Special Spring and Fall Mixture."
4. "Penniman's Special Guano."
5. "Truckers' Choice."

BARTENSCHLAGER, J. H., Stewartstown, Pa.

1. "Bartenschlager's Champion Bone Phosphate."

BAUGH & SONS COMPANY, No. 20 S. Delaware Avenue, Philadelphia, Pa.

1. "Baugh's Bone Meal, Warranted Pure."
2. "Baugh's Pure Dissolved Animal Bone."
3. "Export Bone with Potash."
4. "Baugh's Animal Bone and Potash—Compound for all Crops."
5. "The Twenty-five Dollar Phosphate."
6. "Baugh's Double Eagle Phosphate."
7. "Baugh's General Crop Grower—For all Crops."
8. "Baugh's Soluble Alkaline Super-Phosphate."
9. "Baugh's Wheat Fertilizer—For Wheat and Grass."
10. "Baugh's Potato Fertilizer."
11. "Baugh's Corn Fertilizer—For Sugar Corn and Garden Truck."
12. "The Wrapper Leaf Brand—A Special Manure for Seed Leaf Tobacco."
13. "Baugh's Special Potato Manure."
14. "Baugh's High Grade Acid Phosphate."
15. "Baugh's Ammoniated Soluble Alkaline."

BAUGHMAN, WILLIAM F., Rinely, Pa.

1. "P. & T. Special."
2. "Ammoniated Bone Phosphate."
3. "Harvest Queen Phosphate."

BAXTER, H. V., Chester, Pa.

1. "Pure Ground Bone."
2. "IXL Phosphate."

BERG COMPANY, THE, Port Richmond, Philadelphia, Pa.

1. "Berg's Special Potato Guano."
2. "Berg's Lymph Guano for all Crops."
3. "Berg's $35.00 Potato Manure."
4. "Berg's Standard Bone Manure."
5. "Berg's Pure Dissolved Bone and Potash."
6. "Berg's Pure Raw Bone Fine."
7. "Berg's Special $25.00 Bone Manure."
8. "Berg's Truckers' Jay Guano."

BERGER BROTHERS, Easton, Pa.

1. "Berger Bros. H. G. Acid Phosphate."
2. "Peerless."

BIRELY, A. D. & SONS, Ladiesburg, Md.

1. "Ammoniated Bone Phosphate."
2. "Special Mixture, Wheat and Grass."
3. "Dissolved Ammoniated Bone and Potash."

3. "Wheat and Grass."
4. "Lehigh Super-Phosphate."
5. "Potato and Truck."

BLAKER, A. H., & CO., Fox Chase, Philadelphia, Pa.

1. "Blaker's Acid Phosphate."
2. "Blaker's Special for General Use."
3. "Blaker's Special for Potatoes."
4. "Blaker's Ground Bone."

BLOCHER, D., & CO., Gettysburg, Pa.

1. "Dissolved Raw Bone and Potash."
2. "High Grade Super-Phosphate of Bone."
3. "Ammoniated Soluble Bone Phosphate."
4. "Alkaline Bone."
5. "Dissolved Bone Phosphate."

BONDAY, JAMES, JR., & CO., No. 302 Merchants' Bank Building, Baltimore, Md.

1. "Sulphate of Potash."
2. "Muriate of Potash."
3. "German Kainit—Old Reliable Brand."

BOWKER FERTILIZER COMPANY, THE, No. 43 Chatham Street, Boston, Mass.

1. "Stockbridge Potato and Vegetable Manure."
2. "Bowker's Potash or Staple Phosphate."
3. "Bowker's Sure Crop Phosphate."
4. "Bowker's Ammoniated O. I. O."
5. "Bowker's Super-Phosphate and Potash."
6. "Bowker's Apex Phosphate."
7. "Bowker's Dissolved Bone Phosphate."
8. "Bowker's 6 Per Cent. Potato Fertilizer."
9. "Bowker's Potash Bone."
10. "Bowker's Empire State Bone Phosphate."
11. "Bowker's Hill and Drill Phosphate."
12. "Bowker's Farm and Garden Phosphate."
13. "Bowker's Wheat Grower."
14. "Bowker's Market Garden."
15. "Bone Meal."

BRADLEY & GREEN FERTILIZER CO., Ninth Street and Girard Avenue, Philadelphia, Pa.

1. "Potato Guano No. 1."
2. "Harvest Home."
3. "High Grade Acid Phosphate."
4. "Popular Phosphate—Special for Wheat."
5. "Standard Bone Phosphate—For Corn, Wheat and Peas."
6. "Market Garden."
7. "Seven Per Cent Ammoniated Guano."

BRILLINGER, HORACE, Emigsville, Pa.

1. "Brillinger's Special Wheat, Corn and Grass Mixture.
2. "Standard High Grade Phosphate."

BROWN, J, W., Tilden, York County, Pa.

1. "No. 7. Compound Fertilizer."

BRUBACHER, ELIAS S., Millbach, Pa.

1. "Wheat and Grass Special."

BUCYRUS FERTILIZER CO., THE, Bucyrus, O.

1. "Superior Pure Ground Bone."
2. "Bucyrus Bone Meal."
3. "Bucyrus Guano."
4. "Buckeye Wheat Grower."
5. "Potter's Standard Phosphate."
6. "Natural Plant Food."
7. "Dissolved Bone."
8. "Acid Phosphate."

CAMBRIA FERTILIZER COMPANY, Johnstown, Pa.

1. "Pure Fine Ground Bone Dust."
2. "Lion Ammoniated Bone Phosphate."
3. "Standard Phosphate."
4. "Corn and Potato Manure."
5. "B. & B. Phosphate."

CHICAGO FERTILIZER CO., THE, Security Building, Chicago, Ill.

1. "Mt. Pleasant Phosphate."
2. "No. 1 Acid Phosphate."
3. "Bone, Blood and Potash."
4. "Potash Special."
5. "Corn and Wheat Special."

CINCINNATI PHOSPHATE CO., THE, Cincinnati, O.

1. "Capitol Wheat Grower."
2. "Capitol Grain and Grass Grower."
3. "Capitol Dissolved Bone and Potash."
4. "Capitol Super-Phosphate."
5. "Capitol Tobacco Food."
6. "Capitol Ground Bone."

COE COMPANY, E. FRANK, No. 133 Front Street, New York, N. Y.

1. "High Grade Soluble Bone."
2. "XXV Phosphate. (Ammoniated Bone.)"
3. "Prize Brand Grain Fertilizer."
4. "Special Dissolved—Bone and Potash."
5. "High Grade Acid Phosphate."
6. "Pennsylvania Grain Special."
7. "Columbian Corn Fertilizer."
8. "Columbian Potato Fertilizer."
9. "XXX Acid Phosphate."

COPE, HENRY, & COMPANY, Lincoln University, Pa.

1. "Acid Phosphate."
2. "Soluble Bone and Potash."
3. "Ammoniated Bone Phosphate."
4. "Pure Bone Phosphate."
5. "Potato and Corn Phosphate."
6. "Dead Shot Phosphate."
7. "Pure Ground Bone."
8. "Queen of Elk Valley."
9. "Wheat Grower and Complete Manure."
10. "High Grade Soluble Bone and Potash."
11. "Pure Steamed Bone."

COPE, JOSIAH & COMPANY, Lincoln University, Pa.

1. "Pure Bone Phosphate."
2. "Try Me Bone Phosphate."
3. "Ammoniated Bone Phosphate."
4. "Wheat and Grass Special."
5. "Potato and Tobacco Phosphate."
6. "Acidulated Phosphate."
7. "Soluble Bone and Potash."
8. "Ground Steamed Bone."
9. "Ground Raw Bone."
10. "High-Grade Soluble Bone and Potash."

CRANSTON COMPANY, J. A., Wilmington, Del.

1. "W. B. Raw Bone Super-Phosphate."
2. "Pennsylvania Super-Phosphate."
3. "Horse Shoe Soluble Bone."
3. "Horse-Shoe Soluble Bone."

DARON, E., Dover, Pa.

1. "Daron's Harvest King Bone Phosphate."

DICKEY, J. SCOTT, No. 630 Prince Street, Lancaster, Pa.

1. "Dickey's Pulverized Tobacco Stem Fertilizer."

DOWNWARD & COMPANY, JAMES G., Coatesville, Pa.

1. "Ammoniated Bone Phosphate."
2. "Soluble Bone and Potash."
3. "Wheat and Grass Fertilizer."
4. "Acid Phosphate Rock."
5. "Royal Bone Phosphate."
6. "Special Potato Phosphate."
7. "Special Corn Manure."
8. "Pure Ground Bone."
9. "Pioneer Raw Bone Phosphate."
10. "Special Asparagus Mixture."

DUNGAN, WALLACE, Doylestown, Pa.

1. "Pebel Hill Home Made Animal Bone Mixture."
2. "Bone Flour."

EASTERN CHEMICAL COMPANY, No. 620 Atlantic Avenue, Boston, Mass.

1. "Imperial Liquid Plant Food."

EBY, AMOS, Lehman Place, Pa.

1. "Pequea Bone."
2. "Pequea Economy."
3. "Pequea Ammoniated."
4. "Pequea Bone for Potatoes."
5. "Farmers' Mixture."

EUREKA FERTILIZER COMPANY, Perryville, Md.

1. "Farmers' Favorite Bone Phosphate."
2. "Standard Bone Phosphate."
3. "Grain and Grass Mixture."
4. "Corn and Potato Special."
5. "P. & P. Super-Phosphate."
6. "Potato and Vegetable Fertilizer."
7. "Imperial Bone Phosphate."
8. "Fish, Rock and Potash."
9. "Alkaline Bone and Potash."
10. "Ground Bone."
11. "Eureka Complete Fertilizer."

EWING, WASHINGTON, Landenberg, Pa.

1. "Pure Raw Bone."
2. "Eclipse Raw Bone Phosphate."
3. "Waste Land Potato Phosphate."

FAIRLAMB, R. C., & SONS, Brandywine Summit, Pa.

1. "Potato Special."
2. "Corn Special."
3. "Wheat and Grass Special."

FARMERS' FERTILIZER COMPANY, Westminster, Md.

1. "No. 3 Bone Phosphate."
2. "XX Bone Phosphate."
3. "Carroll Bone Phosphate."
4. "P. A. & P. Phosphate."
5. "Acid Phosphate."

FARMER, W. S., & CO., No. 21 S. Gay Street, Baltimore, Md.

1. "Standard Phosphate."
2. "Harvest Queen Phosphate."
3. "Clyde Brand Phosphate."
4. "B. & P. Phosphate."
5. "Dissolved S. C. Bone."

FOGLEMAN, W. H., Williamsport, Pa.

1. "Pure Bone and Potash."

FRETZ, MAHLON, Sellersville, Pa.

1. "Fretz's Standard Bone Phosphate."

FULTON, JAMES, & SONS CO., Stewartstown, Penna.

1. "Fulton's Corn and Wheat Fertilizer."

GAWTHROP, JOSEPH R., Kennett Square, Pa.

1. "Fine Ground Raw Bone Meal."
2. "Champion Bone Fertilizer for Wheat and Grass."
3. "Complete Ammoniated Bone Phos. for Corn, Oats, Potatoes and Wheat."
4. "Acid Phosphate Rock."

GLICK, I. N., R. F. D. No. 6, Lancaster, Pa.

1. "Up to Date Grain and Grass Grower."

GRIFFITH & BOYD, No. 9 S. Gay Street, Baltimore, Md.

1. "Cereal Bone Plant Food."
2. "Valley Fertilizer."
3. "Peerless Fertilizer."
4. "High Grade Acid Phosphate."
5. "Harvest Queen Phosphate."
6. "XX Potash Manure."
7. "Original Super-Phosphate."
8. "Farmers' Potato Manure."
9. "Ammoniated Bone Phosphate."
10. "Farmers' Improved Phosphate."
11. "Double Strength Tobacco Grower."
12. "Spring Crop Grower."
13. "Pure Fine Ground Bone Meal."
14. "Fish, Bone and Potash."
15. "Special Grain Grower."
16. "Royal Potash Guano."

GROVE, A. M., & CO., Muddy Creek Forks, Pa.

1. "A. M. G. & Co's Standard Bone Phosphate."

HAGER, H. F., Quakertown, Pa.

1. "Hager's Ammoniated Super-Phosphate."
2. "Panic Phosphate."
3. "Farmers' Favorite Phosphate."

HANOVER FERTILIZER COMPANY, N. E. Cor. Gay and Lombard Streets, Baltimore, Md.

1. "Dissolved S. C. Rock."
2. "Royal Bone and Potash."
3. "Farmers' Crop Winner."
4. "Blood and Bone Compound."

5. "Excelsior Combine."
6. "Klondyke Special."
7. "Pure Bone Meal."
8. "High Grade Bone Potash.
9. "Dissolved Raw Bone."

HARDY PACKING COMPANY, THE, No. 189 Madison Street, Chicago, Ill.

1. "Hardy's Crop Producer."
2. "Hardy's Tankage, Bone and Potash."
3. "Hardy's Potash Fertilizer."
4. "Hardy's Phosphate and Potash."

HARTRANFT, FRANK, Coatesville, Pa.

1. "Ground Bone."
2. "Coon Bone Phosphate."
3. "Ammoniated Bone Phosphate."
4. "Potato Phosphate."
5. "Special Phosphate."

HASTINGS, WILLIAM S., & SON., Atglen, Pa.

1. "Clear Acid Phosphate."
2. "Atglen Corn and Potato Guano."
3. "Grain and Grass Special."
4. "Soluble Bone and Potash."

HESS, S. M., & BRO., S. E. Cor. Fourth and Chestnut Streets,, Philadelphia, Pa.

1. "Ammoniated Bone Super-Phosphate."
2. "Keystone Bone Phosphate."
3. "Wheat and Grass Manure."
4. "Emperor Phosphate."
5. "Potato and Truck Manure."
6. "High Grade Acid Phosphate."
7. "Ground Bone."
8. "Special Compound."
9. "Special Corn Manure."
10. "Special Potato Manure."
11. "Soluble Bone."
12. "Soluble Bone and Potash."
13. "Tobacco Manure."
14. "Fish and Potash Manure."
15. "The Scientific Manure."

HOFFMAN, P., & BRO., Raubsville, Pa.

1. "Potato Phosphate."
2. "King Phosphate."

HEWETT FERTILIZER COMPANY, THE, Scranton, Pa.

1. "Pure Ground Bone."

HUBBARD & COMPANY, M. P., & CO., No. 612 Equitable Building, Baltimore, Md.

1. "Hubbard's Bermuda Guano."
2. "Celebrated Dissolved Bone Phosphate for General Use."

3. "Farmers' Acme."
4. "Farmers' Old Economy."
5. "High Grade Soluble Bone and Potash."
6. "Hubbard's Excelsior Bone Phosphate."
7. "Pennsylvania Special Potato Grower."

HUBBARD FERTILIZER COMPANY, THE, No. 708 Merchants' Bank Building, Baltimore, Md.

1. "Hubbard's Standard Bone Super-Phosphate."
2. "Hubbard's Royal Ensign—For Early Market Vegetables."
3. "Hubbard's Farmers' IXL Super-Phosphate."
4. "Hubbard's Wheat Grower's Jewel."
5. "Hubbard's Oriental Phosphate."
6. "Hubbard's Columbia Gem Phosphate."
7. "Hubbard's Soluble Bone and Potash."
8. "Hubbard's High Grade Soluble Tennessee Phosphate."
9. "Hubbard's Trucker's 7 Per Cent. Royal Seal Compound."

INDEX COMPANY, THE, No. 426 N. Third Street, Philadelphia, Pa.

1. "Radix Fertilizer."
2. "Index Bone Phosphate."
3. "Index Ground Bone."
4. "Index Bone Meal."
5. "Index Bone Flour."
6. "Spiro Bone Meal."
7. "Michell's Bone Phosphate."
8. "Michell's Pure Bone Meal."

INTERNATIONAL SEED COMPANY, Rochester, N. Y.

1. "International Grain and Grass Fertilizer."
2. "International Potato and Truck Manure."
3. "International A. L. Special Manure."

JARECKI COMMERCIAL COMPANY, Sandusky, Ohio.

1. "Lake Erie Fish Guano."
2. "Fish and Potash Grain Special."
3. "Number One Fish Guano."
4. "C. O. D. Phosphate."
5. "Pure Ground Bone."
6. "St. Bernard Phosphate."
7. "Dissolved Bone Black Wheat Special."
8. "Fish and Potash Potato and Tobacco Food."
9. "O. K. Fertilizer."
10. "Dissolved Bone with Potash."

JONES, W. C., SONS, Doe Run, Pa.

1. "High Grade Dissolved S. C. Rock."
2. "Dissolved Bone Phosphate."

KENDERDINE, T. S., & SONS, Newtown, Pa.

1. "Kenderdine's Potato Phosphate."
2. "Kenderdine's Bone Phosphate."
3. "Kenderdine's Ammoniated Phosphate."

KUHNS, DAVID, Lehighton, Pa.

1. "Pure Ground Bone Meal."

KURTZ & STUNKARD, Green Bank, Pa.

1. "Conestoga Regulator."
2. "Conestoga Fancy."

LACKAWANNA FERTILIZER & CHEMICAL CO., Moosic, Pa.

1. "Moosic Phosphate."
2. "Special Manure."
3. "Our Admiral Dewey."
4. "Bone Super-Phosphate."
5. "Alkaline Bone."
6. "Warranted Pure Ground Bone."
7. "Acid Phosphate."
8. "Big Yield."
9. "Wyoming Guano."
10. "Kali Chief."

LANCASTER CHEMICAL COMPANY, Lancaster, Pa.

1. "Tobacco and Vegetable."
2. "Dewey Brand."
3. "Pure Dissolved Animal Bone and Potash."
4. "Rising Sun Animal Bone."
5. "Pure Dissolved Animal Bone."
6. "Flag Brand."
7. "Hard Times Fertilizer."
8. "Economist."
9. "Acid Phosphate."
10. "Keystone Brand."
11. "Alkaline Bone."
12. "Bone Meal."
13. "Special Potato Manure."

LEBERNIGHT, B. F., Red Lion, Pa.

1. "Lebernight's Standard Ammoniated Bone Phosphate."

LEIB, J. C., & Co., Stewartstown, Pa.

1. "Gemmills Mixture."

LETHERBURY, D. A., Chester, Pa.

1. "Chester Brand Bone Phosphate."

LEVAN, DANIEL, Lebanon, Pa.

1. "Wheat and Grass Special."
2. "Keystone Bone Fertilizer."
3. "Bone and Potash Compound."

LISTER'S AGRICULTURAL CHEMICAL WORKS, Newark, N. J.

1. "Lister's Animal Bone and Potash."
2. "Lister's Animal Bone and Potash No. 2."
3. "Lister's Corn and Potato Fertilizer."
4. "Lister's Success Fertilizer."
5. "Lister's Standard Pure Bone Super-Phosphate."
6. "Lister's Potato Fertilizer No. 2."
7. "Lister's Special Wheat Fertilizer."
8. "Lister's Special 10 Per Cent. Potato Fertilizer."
9. "Lister's "G" Brand."
10. "Lister's Special Crop Producer."
11. "Lister's Ammoniated Dissolved Bone Phosphate."
12. "Lister's Harvest Queen Phosphate."
13. "Lister's Potato Manure."
14. "Lister's U. S. Super-Phosphate."
15. "Lister's Alkaline Bone."
16. "Lister's 3—6—10 for Potatoes."
17. "Lister's Celebrated Ground Bone Acidulated."

McCALMONT & CO., Bellefonte, Pa.

1. "McCalmont & Co's. $25.00 Ammoniated Bone Super-Phosphate."

MAPES FORMULA AND PERUVIAN GUANO CO., No. 143 Liberty Street, New York, N. Y.

1. "Mapes Potato Manure."
2. "Mapes Tobacco Starter Improved."
3. "Mapes Tobacco Manure (Wrapper Brand)."
4. "Mapes Fruit and Vine Manure."
5. "Mapes Vegetable Manure or Complete Manure for Light Soils."
6. "Mapes Average Soil Compound Manure."
7. "Mapes Economical Potato Manure."
8. "Mapes Cauliflower and Cabbage."
9. "Mapes Corn Manure."
10. "Mapes Complete Manure, "A" Brand."
11. "Mapes Complete Manure for General Use."
12. "Mapes Ammoniated Dissolved Bone with Potash."
13. "Mapes Cereal Brand."
14. "Mapes Grain Brand."
15. "Mapes General Crop Brand."
16. "Mapes Top Dresser Improved—Half Strength."

MARKEL, NOAH, Seitzland, Pa.

1. "Markel's Ammoniated Bone Phosphate."
2. "Markel's Potato Grower."
3. "Markel's Electric Phosphate."

MARTIN CO., THE D. B., 1204 Land Title Building, Philadelphia, Pa.

1. "Special Dissolved Bone and Potash Compound."
2. "Claremont Dissolved Bone and Potash."

MEHRING, FREDERICK, Bruceville, Pa.

1. "Dissolved Raw Bone."
2. "Twenty-six Dollar Phosphate."
3. "General Crop Grower."
4. "Acid Phosphate."

MILLER FERTILIZER COMPANY, No. 411 E. Pratt Street, Baltimore, Md.

1. "Ammoniated Dissolved Bone."
2. "Harvest Queen."
3. "Special Potato."
4. "Hustler Phosphate."
5. "W. G. Phosphate."
6. "Standard Phosphate."
7. "Clinch Phosphate."

MORRIS, NELSON & CO., Union Stock Yards, Chicago, Ill.

1. "Big Two. Pure Bone Meal."
2. "Big Three. Bone Phosphate."
3. "Big Four. Bone Phosphate."
4. "Big Five. Bone Phosphate."

MOWREY LATSHAW HARDWARE CO., THE, Spring City, Pa.

1. "Red Clover Brand."

NASSAU FERTILIZER CO., No. 5 Beaver Street, New York, N. Y.

1. "Soluble Bone and Potash."
2. "Grass and Grain Fertilizer."
3. "Potash and Phosphate."
4. "Wheat and Grass Grower."
5. "General Favorite."
6. "Nassau Practical."
7. "Common Sense Fertilizer."
8. "The Harvester."
9. "Plow Brand."

NELLER, AUG., & CO., Stewartstown, Pa.

1. "Prolific Phosphate."
2. "Special Compound Phosphate."

NEW JERSEY AGRICULTURAL CHEMICAL CO., Newark, N. J.

1. "Potato Manure."
2. "Champion."
3. "Russell's Ground Bone."
4. "Russell's Ammoniated Dissolved Bone Phosphate."
5. "Russell's Special Corn Manure."
6. "Harvest Queen."

NEWPORT, WILLIAM C., CO., Willow Grove, Pa.

1. "Evan's Brand Potato and Tobacco Manure."
2. "Rectified Phosphate."
3. "Gilt Edge Potato Manure."
4. "Fish, Bone and Potash."
5. "Farmers' Ammoniated Bone Phosphate."
6. "Grain and Grass Special."
7. "Soluble Bone and Potash."
8. "Acid Phosphate."
9. "Bone Meal."
10. "Newport's Special Compound for Wheat and Grass."
11. "No. 1 Bone Phosphate."
12. "Truckers' Joy."
13. "Potato, Tobacco and Truck Guano."

OBER, G., & SONS, No. 33 S. Gay Street, Baltimore, Md.

1. "Ober's Special Plant Food."
2. "Ober's Farmers' Mixture."
3. "Ober's Dissolved Bone Phosphate and Potash."
4. "Ober's Dissolved Bone Phosphate."
5. "Ober's Independent Ammoniated Super-Phosphate."

OHIO FARMERS' FERTILIZER CO., Columbus, O.

1. "Acid Phosphate."
2. "Superior Phosphate."
3. "Soluble Bone and Potash."
4. "General Crop and Fish Guano."
5. "Corn, Oats and Wheat Fish Guano."
6. "Wheat Maker and Seeding Down."

OSCEOLA FERTILIZER COMPANY, Osceola Mills, Pa.

1. "Pie Brand Ground Bone."
2. "Ideal Manure."

OWENS, W. C., Philipsburg, Pa.

1. "Owens' Ammoniated Phosphate."

PATAPSCO GUANO COMPANY, P. O. Box 213, Baltimore, Md.

1. "Patapsco Pure Ground Bone."
2. "Patapsco Soluble Bone and Potash."
3. "Patapsco Fish Guano."
4. "Patapsco Special Wheat Compound."
5. "Sea Gull Guano."
6. "Coon Brand Guano."
7. "Baltimore Soluble Phosphate."
8. "Patapsco Dissolved S. C. Bone."
9. "Grange Mixture."
10. "Patapsco Grain and Grass Producer."
11. "Patapsco Early Trucker."

12. "Patapsco Tobacco and Potato Fertilizer."
13. "Patapsco Corn and Tomato Fertilizer."
14. "Patapsco High Grade Bone and Potash."
15. "Battle Ax Phosphate."

PATTERSON FERTILIZER CO., No. 4025 Market Street, Philadelphia, Pa.

1. "Patterson's Mineral Compound."

PENNSYLVANIA AMMONIA AND FERTILIZER CO., LIM., Harrisburg, Pa.

1. "Potato, Vegetable and Tobacco."
2. "Dauphin Brand."
3. "Pure Ground Bone."
4. "Capital Bone Super-Phosphate."
5. "Royal Mixture."
6. "Soluble Bone and Potash."

PERKINS, A. W., & CO., Rutland, Vt.

1. "Plantene."

PERKINS, J. DOUGLASS, Coatesville, Pa.

1. "Perkins' Monarch Phosphate."
2. "Perkins' Ammoniated Bone Phosphate."
3. "Perkins' Special Bone Manure."
4. "Perkins' Globe Phosphate."
5. "Perkins' Pure Bone Meal."
6. "Perkins' Acidulated Phosphate."

PIEDMONT-MT. AIRY GUANO CO., THE, No. 109 Commerce Street, Baltimore, Md.

1. "Levering's Standard."
2. "Piedmont High Grade S. C. Bone."
3. "Piedmont Royal Ammoniated Bone and Potash."
4. "Piedmont Soluble Bone and Potash."
5. "Piedmont Pure Raw Bone Mixture."
6. "Levering's Harvest Queen."
7. "Levering's IXL Phosphate."
8. "Diamond (S) Soluble Bone."
9. "Piedmont Pennsylvania Potato Producer."
10. "Piedmont Special Potato Goods."
11. "Levering's Ammoniated Bone."

PITTSBURG PROVISION CO., Pittsburg, Pa.

1. "No. 1 Pure Raw Bone Meal."
2. "Pure Raw Bone Meal."
3. "Crescent Butchers' Ground Bone."
4. "Pure Bone with Potash."
5. "Corn and Potato Fertilizer."
6. "Keystone Fertilizer."

7. "Guano Fertilizer."
8. "Acid Phosphate."
9. "Phosphate and Potash."

POLLOCK, R. H., No. 51 S. Gay Street, Baltimore, Md.

1. "Dissolved S. C. Bone."
2. "Victor Bone Phosphate."
3. "Superior Corn and Tomato Fertilizer."
4. "Owl Brand Guano."
5. "Special Potato and Tobacco Fertilizer."
6. "Special Wheat Grower."
7. "Ammoniated Bone Phosphate."
8. "Soft Ground Bone."
9. "Dissolved Animal Bone."

PUGH & LYON, Oxford, Pa.

1. "Ground Raw Bone."
2. "Bone Phosphate."

RAMSBURG FERTILIZER COMPANY, Frederick, Md.

1. "Excelsior Plant Food."
2. "Old Virginia Compound."
3. "Ammoniated Bone Phosphate."
4. "Alkaline Phosphate."
5. "Dissolved Bone Super-Phosphate."
6. "Ramsburg's Queen."

RASIN-MONUMENTAL COMPANY, No. 300 Water Street, Baltimore, Md.

1. "Rasin's Empire Guano."
2. "Rasin's Ammoniated Super-Phosphate."
3. "Rasin's Bone and Potash Fertilizer."
4. "Rasin's Acid Phosphate."
5. "Rasin's IXL Fertilizer."
6. "Special Formula for Corn and Buckwheat."
7. "Seawall Special."
8. "Rasin's Ammoniated Alkaline Phosphate."

RAUH, E., & SONS., No. 419 S. Penn Street, Indianapolis, Ind.

1. "Dissolved Bone and Potash."
2. "Soluble Bone."
3. "Ideal Phosphate."
4. "Fish Guano."
5. "Our Special."

READING CHEMICAL AND FERTILIZING CO., LIM., Reading. Pa.

1. "Potato and Vegetable Brand."
2. "Neversink Brand."
3. "A. A. Brand."
4. "Mt. Penn Brand."
5. "Reading Star Brand."

REESE, JACOB, No. 400 Chestnut Street, Philadelphia, Pa.

1. "Odorless Slag Phosphate."

REICHARD, J. G. & BRO., Allentown, Pa.

1. "The Lehigh Potato Manure."
2. "Surface Phosphate."
3. "Little Giant Phosphate."

RICE, HAMPTON, Lumberville, Pa.

1. "W. Kenderdine's A. A. Phosphate."
2. "W. Kenderdine's A. B. Phosphate."

RIVERSIDE ACID PHOSPHATE, Warren, Pa.

1. "Harvest Moon Phosphate."
2. "Rich-acre Phosphate."
3. "Old Gold Phosphate."
4. "Phosphate and Potash."

SALE, GEORGE F. (Sandiford), Philadelphia, Pa.

1. "Geo. F. Sale's Special Manure for all Crops."

SCHAAL-SHELDON FERTILIZER CO., Erie, Pa.

1. "Sheldon's Empire."
2. "Sheldon's Farmers' Favorite."
3. "Schaal's Standard."
4. "Sheldon's Grass, Grain and Potato."
5. "Schaal's Corn and Potato."
6. "Sheldon's Guano."
7. "Pure Bone Meal."
8. "Dissolved Bone and Extra Potash."
9. "Dissolved Bone and Potash."
10. "Dissolved Bone."

SCHMUCHER, A. B., Hazleton, Pa.

1. "Hazel Brand."

SCIENTIFIC FERTILIZER CO., THE, Pittsburg, Pa.

1. "Scientific Corn and Grain Fertilizer."
2. "Scientific Economy."
3. "Scientific Bone, Meat and Potash Fertilizer."
4. "Scientific Potato Fertilizer."
5. "Scientific Dissolved Bone Fertilizer."
6. "Scientific Phosphate and Potash Fertilizer."
7. "Bone and Meat."
8. "Pure Raw Bone Meal."
9. "High Grade Acid Phosphate."
10. "Scientific Wheat and Clover Fertilizer."
11. "Scientific Grain Grower."
12. "Scientific Bone and Potash Fertilizer."
13. "Patrons' Special."

SCOTT FERTILIZER CO., THE, Elkton, Pa.

1. "Sure Growth Super-Phosphate."
2. "Standard Phosphate."
3. "Elk Head Super-Phosphate."
4. "Corn and Oats Grower."
5. "Tip Top Soluble Bone."
6. "Scott's Potato Grower."
7. "Potato, Truck and Tobacco Grower."
8. "Wheat and Grass Grower."
9. "Tip Top and Potash."
10. "Sure Growth Compound."

SHENANDOAH FERTILIZER COMPANY, Shenandoah, Pa.

1. "Standard Potash Brand."
2. "Ringtown Clover."
3. "Gold Eagle."
4. "N. & S. Complete Clover."
5. "Special Wheat."
6. "Pure Ground Bone."

SHOEMAKER, M. L., & CO., Cor. Delaware Avenue and Venango Streets, Philadelphia, Pa."

1. "Swift Sure Phosphate for General Use."
2. "Swift Sure Phosphate for Potatoes."
3. "Swift Sure Phosphate for Tobacco."
4. "Swift Sure Special 10 Per Cent. Potato Fertilizer No. 1."
5. "Swift Sure Special 10 Per Cent. Potato Fertilizer No. 2."
6. "Swift Sure Guano for Tomatoes, Truck and Corn."
7. "Swift Sure Guano for Fall Trade."
8. "Swift Sure New Jersey Special for Oats."
9. "Swift Sure New Jersey Special for Wheat and Clover."
10. "Swift Sure Bone Meal."
11. "Swift Sure Dissolved Bone."
12. "Good Enough Phosphate."
13. "Echo Phosphate."
14. "Twenty-three Dollar Phosphate."
15. "Dissolved S. C. Rock."
16. "Pure Raw Bone Meal."
17. "Dissolved Bone and Potash."

SICKLER, CHAS. A., & BRO., Wilkes-Barre, Pa.

1. "Special Manure for Potatoes and Vegetables."
2. "Vegetable and Vine Fertilizer."
3. "Empire Phosphate."
4. "King Phosphate."
5. "Monarch Phosphate."
6. "Pure Ground Bone."
7. "Graves Potato and Tobacco Manure."
8. "Peerless Phosphate."
9. "Empire Corn Fertilizer."

SIMON, [illegible]. A., Maud P. O., Pa.

1. "Truck and Corn."
2. "Potato Grade."
3. "General Use."

SLAGLE, E. A., Paxinos, Pa.

1. "Xtra Bone Phosphate."

SMYSER, H. H., York, Pa.

1. "Chicago Soluble Bone."
2. "Chicago Crop Grower."
3. "Chicago Bone and Tankage."
4. "Chicago Bone and Potash."

SOUTHERN FERTILIZER COMPANY, York, Pa.

1. "Ox Brand Ammoniated Dissolved Bone."
2. "Ox Brand Special Potato Grower."
3. "Ox Brand General Crop Grower."
4. "Ox Brand Farmers' Choice Brand."
5. "Ox Brand Dissolved Bone Phosphate."
6. "Ox Brand Soluble Bone and Potash."
7. "Ox Brand Queen of the Harvest."
8. "Ox Brand Pure Ground Bone."
9. "Bone and Potash Mixture."

STERNER, E. H., Codorus, Pa.

1. "Sterner's Dissolved Bone Phosphate."

STRAINING, JOHN E., No. 1752 N. Cameron Street, Harrisburg, Pa.

1. "Bone and Meat Fertilizer."

SWIFT & COMPANY, Union Stock Yards, Chicago, Ill.

1. "Swift's Super-Phosphate."
2. "Swift's Complete Fertilizer."
3. "Swift's Ammoniated Bone."
4. "Swift's Pure Raw Bone Meal."
5. "Swift's Bone Meal."
6. "Swift's Diamond (S) Phophate."
7. "Swift's Onion and Potato Special."
8. "Swift's Special Bone Meal."
9. "Swift's Champion Wheat Grower."
10. "Swift's Champion Corn Grower."
11. "Swift's Phosphate and Potash."
12. "Swift's Pure Acid Phosphate."
13. "Swift's Vegetable Grower."
14. "Swift's Sugar Beet Grower."
15. "Swift's Special Phosphate and Potash."

TAYLOR PROVISION COMPANY, THE, Trenton, N. J.

1. "Special Potato."
2. "Corn and Truck."
3. "Ammoniated Dissolved Bone."

TEMPIN, J. M., Honeybrook, Pa.

1. "No. 3. Farmers' Complete Fertilizer."
2. "No. 4. Atlas Brand."
3. "No. 5. High Grade Acid Phosphate."
4. "No. 8. High Grade Potash Manure."
5. "No. 16. Cereal Fertilizer."

THOMAS, D. A., Hagerstown, Md.

1. "Thomas' Bone Mixture."
2. "Thomas' Mixture."
3. "Dissolved Bone Phosphate."

THOMAS, HAINES & CO., Malvern, Pa.

1. "New Century Crop Grower."

THOMAS, JAMES, Williamsport, Pa.

1. "Thomas' High Grade Bone Super-Phosphate."
2. "Thomas' Klondyke Brand."
3. "Thomas' High Grade Potato and Tobacco Manure."
4. "Thomas' Special Compound for Wheat, Oats, Corn and Grass."
5. "Thomas' Standard Bone Phosphate."
6. "Thomas' Florida Bone Phosphate."
7. "Thomas' Dissolved Florida Bone and Potash Phosphate."

THOMAS, I. P., & SONS COMPANY, No. 2 S. Delaware Avenue, Philadelphia, Pa.

1. "S. C. Phosphate."
2. "Farmers' Choice Bone Phosphate."
3. "Normal Bone Phosphate."
4. "Improved Super-Phosphate."
5. "Special Corn Fertilizer."
6. "Alkaline Bone."
7. "Special Alkaline Bone."
8. "Dissolved Phosphate."
9. "Tip Top Raw Bone Super-Phosphate."
10. "Pure Ground Animal Bone."
11. "Potato Fertilizer."
12. "Champion Bone Phosphate."
13. "Superior Super-Phosphate."
14. "Special Truckers' Fertilizer."

TOMLINSON, WATSON, JR., Torresdale, Philadelphia, Pa.

1. "Tomlinson's Potato Fertilizer and Crop Feeder."
2. "Tomlinson's Ammoniated Potato Fertilizer."
3. "Tomlinson's All Crop Fertilizer."
4. "Tomlinson's Market Garden Guano."
5. "Tomlinson's Grain and Grass Fertilizer."

TRENTON BONE FERTILIZER CO., Trenton, N. J.

1. "Trenton Super-Phosphate."
2. "Trenton Corn Mixture."
3. "Trenton $32.00 Potato Manure."
4. "Trenton Potato Manure."
5. "Trenton Excelsior."
6. "Trenton Corn and Truck Fertilizer."
7. "Pure Fine Ground Bone."
8. "Trenton XX Brand Fertilizer."
9. "Trenton Special Potato Manure."

TRINLEY, JACOB, Linfield, Pa.

1. "Pure Raw Bone Meal."
2. "Pure Raw Bone Super-Phosphate."
3. "Grain and Grass Grower."
4. "Ravere Bone Phosphate."
5. "Soluble Bone and Potash."

TUSCARORA FERTILIZER COMPANY, THE, Port Royal, Pa.

1. "Ammoniated Phosphate."

TUSTIN, I. J., Phoenixville, Pa.

1. "Pickering Valley Special for Potatoes."
2. "Pickering Valley Special."
3. "Pickering Valley High Grade."

TYGERT, THE, J. E., COMPANY, No. 42 S. Delaware Avenue, Philadelphia, Pa.

1. "Bone Phosphate."
2. "Ground Bone."
3. "Soluble Bone and Potash."
4. "Potato Guano."
5. "Ammoniated Super-Phosphate."
6. "Popular Phosphate."
7. "Golden Harvest Phosphate."
8. "Acid Phosphate."

ULMER, JACOB, PACKING COMPANY, Pottsville, Pa.

1. "Ulmer's Blood, Meat and Bone Super-Phosphate."

UNIONTOWN FERTILIZER WORKS, Uniontown, Pa.

1. "Fell's Pure Ground Bone."
2. "Fell's Gold Premium Bone Phosphate."
3. "Fell's High Grade Acid Phosphate."

WAHL, EMIL, MANF'G. CO., Nos. 3970-3986 Pulaski Avenue (Nicetown), Philadelphia, Pa.

1. "Emil Wahl's Warranted Pure Philadelphia Button Bone Dust."

WALKER, STRATMAN & COMPANY, Herr's Island, Allegheny, Pa.

1. "Four Fold."
2. "Grain King."
3. "Big Bonanza."
4. "Potato Special."
5. "Meat, Blood and Bone with Potash."
6. "Help Mate."
7. "Phosphoric Acid and Potash."
8. "Bone and Meat."
9. "Pure Raw Bone Meal."
10. "Acid Phosphate."
11. "Grain Manure."
12. "Potash and Bone Phosphate."

WALKER, J. C., & SON, Gap, Pa.

1. "Pride of Pequea."
2. "Pride of Pequea, High Grade."

WALT, F. K., & CO., Supplee P. O., Pa.

1. "Flesh and Bone Phosphate."
2. "Calcine Bone Phosphate."
3. "Sure Growth Phosphate."

WHANN, W. E., William Penn P. O., Pa.

1. "Special Potato and Truck Fertilizer."
2. "Raw Bone Super-Phosphate."
3. "Fish and Potash Fertilizer."
4. "Ammoniated Phosphate."
5. "No. 2 Ammoniated Phosphate."
6. "Special Ammoniated Phosphate."
7. "Soluble Bone and Potash."
8. "Available Ammoniated Phosphate."
9. "South Carolina Phosphate."
10. "Pure Ground Raw Bone."
11. "Sweet Potato and Celery Mixture."

WHANN, JOHN, & SON, No. 28 S. Delaware Avenue, Philadelphia, Pa.

1. "Our Brand Raw Bone Phosphate."
2. "A. A. Acid Phosphate."
3. "J. W. & S. Special Mixture."
4. "Wheat and Grass Mixture."
5. "Reliable Ammoniated Super-Phosphate."
6. "Whann's Soluble Bone and Potash."

WINDLE, DOAN & CO., Coatesville, Pa.

1. "Ground Bone."
2. "Cook's Bone Phosphate."
3. "Ammoniated Bone Phosphate."
4. "Potato Phosphate."

WOOLDRIDGE, THE R. A., COMPANY, No. 33 S. Gay Street, Baltimore, Md.

1. "Florida Acid Phosphate."
2. "German Potash Mixture."
3. "Liberty Bell Potash Mixture."
4. "Champion Giant Phosphate."
5. "Chieftain Bone Stock Phosphate."
6. "Triumph Pure Bone Phosphate."
7. "Special Potato Fertilizer."
8. "Tuckahoe Bone Meal."
9. "Buffalo Bone Stock Phosphate."
10. "Pure Raw Bone."
11. "Sweepstakes, Sure Shot, Truck Phosphate."

YORK CHEMICAL WORKS, York, Pa.

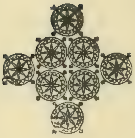
1. "Plow Brand."
2. "Standard Potash."
3. "Prosperity."
4. "Harvest Queen."
5. "New York."
6. "Half and Half."
7. "Red Cross."
8. "Black Cross."
9. "Wheat Special."
10. "Dissolved Phosphate."
11. "Dempwolf's Standard Fertilizer."
12. "Dempwolf's Corn and Oats Special."
13. "Special Tobacco."
14. "Potato and Truck Special."

ZEIGLER, E. H., & CO., Stewartstown, Pa.

1. "Bone Phosphate."
2. "Zeigler's Potato Phosphate."
3. "Zeigler's Mixture."
4. "Zeigler's Crop Grower."

ZOOK, HENRY S., Elverson, Pa.

1. "No. 5. Pride of Chester Corn, Oats and Wheat Fertilizer."
2. "No. 6. Pride of Chester Dissolved Animal Bone Phosphate."
3. "No. 7. Pride of Chester Dissolved Animal Bone Phosphate for General Use."
4. "Zook's Clear Acid Phosphate."



COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN NO. 102.

THE NATURAL IMPROVEMENT OF SOILS.

BY

EDWARD B. VOORHEES, M. A.,
Director of the New Jersey Agricultural Experiment Stations.

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PREFACE.

Harrisburg, Pa., September 1, 1902.

The following Bulletin No. 102, by Edward B. Voorhees, M. A., Director of the New Jersey Agricultural Experiment Station, upon "The Natural Improvement of Soils," discusses this important subject from the standpoint of a scientific investigator, in language familiar to the practical farmer.

Director Voorhees explains the character of the physical differences of soils, the effects of living organisms in the soil upon soil improvement, the conservation of moisture by tillage, the use of lime and the various forage plants in their regeneration.

Soil improvement by cheap and easily available means, is the great problem in modern agriculture. When soils were new and consequently fertile, the securing of sufficient fertility for an abundant crop required almost no expenditure of money, and very little thought, but now when soils in the east are becoming unproductive the question is most important, and farmers are anxiously looking for information which shall help them in restoring their farms to their old state of fertility at minimum cost.

This bulletin will greatly assist those who study it in securing this result, and it is, therefore, commended to all who are interested in the subject of soil improvement for agricultural use.

JOHN HAMILTON,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

New Jersey Agricultural Experiment Stations,
New Brunswick, N. J., August 20, 1902.

Prof. John Hamilton, *Secretary of Agriculture, Harrisburg, Pa.:*

My Dear Sir: I hand you herewith a bulletin on "The Improvement of Soils," prepared at your request. In this bulletin I have taken great pains to collect accurate data, and have attempted to present the matter in such a way as to appeal to the practical farmer.

Very truly yours,
E. B. VOORHEES,
Director.

THE NATURAL IMPROVEMENT OF SOILS.

BY EDWARD B. VOORHEES, M. A., *Director of the New Jersey Agricultural Experiment Stations.*

The farmer's primary source of income is the soil, the success of his operations, therefore, depends upon its original composition and character, its management and the handling of the products raised. The management of a soil, however, is quite as important a factor as the character of the soil itself, for it may be directed in such a way as to result either in rapid impoverishment, or in great improvement in productivity. In other words, the man is the most important factor in farming, as in other lines of business.

How Soils Differ.

In studying the nature of soils, we find that they possess two distinct characteristics, which have a direct bearing upon their fertility, or crop-producing power; one of these characteristics is the chemical, or the power which soils possess of furnishing those constituents that are necessary in the growth of plants, though it is not necessary that soils, perfect from the chemical standpoint, that is, that can furnish an abundance of the essential plant-food constituents for all kinds of plants, shall contain the constituents in the same proportion as they are found in plants. In fact, because of the origin and nature of soils, those constituents which are contained in them in maximum amounts are found in plants in minimum amounts, while on the other hand, those constituents which are contained in plants in maximum amounts are found in minimum amounts in soils, thus making the value of a soil from the chemical standpoint dependent rather upon the relative amounts of the four constituents, which by the continuous growth of plants are removed more rapidly from the soil than the others, viz: nitrogen, phosphoric acid, potash and lime. These are, for this reason, called essential manurial constituents, and the wide differences in soils in respect to their content of the substances which furnish them are due to the changes which were wrought in the surface of the earth during its formation, to those which have taken place since, as well as to those which are going on in a small way even at the present time.

It is believed that the original earth crust contained all the minerals now found in it, and that at the beginning they were distributed more uniformly throughout its mass than at present. In the harder rocks, the sandy particles were cemented together by materials more easily disintegrated and the separation thus made in the course of time enabled the movement of the particles so separated in a different way, the coarser materials were distributed and deposited as gravel and sand in one place, and the finer carried and deposited in another, making the clay; the lime entered partly in solution, and was distributed and finally deposited in another place, thus giving us sandy, clayey and limy soils, all differing from each other in their amount and proportion of both the purely mechanical substances, which serve no other purpose in soils than the support of the plants and in contributing to physical character, and of the chemical substances which contain the essential fertilizing constituents, and which in their decay provide the food in an available form.

In addition to these kinds of soils, there are others of more recent origin, made up largely of vegetable matter, due to its accumulation in a partially decayed state; these are frequently rich in nitrogen and poor in all of the essential mineral constituents. These considerations as to the origin of soils are valuable in indicating their chemical composition and possible potential value.

Chemical Differences in Soils.

In the next place, fertility depends not altogether on the amount and proportion of the essential constituents contained in soils, but also upon the character of the mineral substances which contain them, that is, whether they are of such a character as to be readily disintegrated or broken down, or whether they are hard and dense, and thus resist those agencies which are active in causing such disintegration. It is quite possible for a soil to be rich in all of these constituents, and still be infertile, because the character of the substances making the soil are such as to prevent their ready attack by those agencies which cause the constituents to become active.

Physical Differences in Soils.

The second valuable characteristic of soils is their physical character. This characteristic is not altogether separate and distinct from the chemical, nevertheless it has to do more particularly with the purely mechanical substances contained in soils and their fineness of division, and has an important bearing upon the actual fertility. In order that we may understand this matter more clearly, it is well perhaps to point out that the substances which constitute the bulk of soils are in an insoluble condition, while the plants take up their food in a soluble condition, hence changes must take place in these substances before they can serve as plant food. The plant roots themselves assist to some extent in causing this change, thus rendering the constituents soluble, still, the great factor in this change is the action of those natural forces, water, sun and air. Water has a solvent effect upon the constituents of soils, and unless it can freely penetrate and reach every portion of the soil its power is very much reduced. That is, if the soils are so compact and dense as to prevent the free penetration and movement of water in the soil, the plants are not able to readily obtain their food, and thus make maximum growth and development, because enough is not distributed throughout those soil layers to which the plant roots are limited. On the other hand, soils that are too open and porous, that are made up of rather coarse particles of mineral substances, as, for example, sandy soils, made up chiefly of quartz, the water penetrates and moves too freely, and the dissolved constituents that are present are too readily carried away from those parts of the soil in which the plants obtain their food, thus again not providing the best condition for its appropriation.

Furthermore, the reservoirs of water under these soils, or in the subsoils, and which are also extremely essential, are rapidly depleted, as the water escapes very freely from the soil in the form of vapor, and this prevents the plants from obtaining so large a proportion of the water that is stored in the earth, as if the conditions of soils were such as to prevent the free escape from the surface. Between these two extremes of soils, first, those with very finely divided particles, making the soil too compact and thus impervious to water; and second, those that are made up of coarse particles, we may have a mixture of the two, which is probably well represented by what is understood as a loam, which possesses in part the properties of each in such a degree as to make the movement of the water more nearly perfect in respect to its supply to plants. That is, we obtain the solvent effect of the water, as well as the free movement of it, which contributes both to the solution of constituents and their movement throughout the soil where needed. It, therefore, frequently happens that from soils reasonably rich or even very rich in chemical constituents, results are obtained that are far below what might be expected from the composition of the soil, because their physical character is such as to prevent the movement of water, and consequently the necessary changes which make it possible for the plant to obtain its food. These considerations are also true in a degree in reference to the action of the other natural agencies, air and warmth. Only in the case of those soils which possess good proportions of the various substances making up soils, do we receive the full benefit of Nature's aids.

The Biological Character of Soils.

The physical character of soils, also, has an important bearing upon the question of the living organisms in the soil, whose activity in improving soils is very important, though not appreciated until recent years, and not yet fully understood. Soils are not, as has been believed to some extent in the past, dead things, serving only as banks from which we may draw out deposits of materials, already in a state capable of serving as food, but are rather laboratories, in which the natural agencies, already described, are actively engaged in working over the raw materials, converting them into forms available for use. They contain millions of living creatures, small to be sure, which depend for their life upon air, moisture and the insoluble matter in the soil, the latter of which in the transformation which takes place in the growth of organisms, is changed into forms which the plant can absorb.

It must not be forgotten that these lower orders of life depend for their best growth and development upon the conditions that are favorable for the life and growth of the higher orders of life, namely, food, moisture and warmth, and as the farmer by his practice makes the conditions favorable for their life and thus encourages their growth, he provides for a more rapid change of soil substances, while on the other hand, if he by his practice prevents or in any way reduces the opportunities for the life and growth of these agencies, he reduces in just that degree the possible usefulness of the potential fertility of such soil. For example, the farmer who allows his soil by improper treatment to become compact and hard, thus not permitting the free movement of air and water, is making the conditions unfavorable for the living organisms in the soil, and is preventing in part the change of insoluble into soluble substances, the result of which is food for the plant; while, on the other hand, the farmer who by his practice makes the conditions for life in the soil favorable by controlling the movements of water , warmth and air, obtains from his soil a larger crop, because he has directed in an intelligent way the agencies which assist in the change of soil substance, and which is necessary in order to insure an abundance of available food, which assists in the natural improvement of soils. Improvement of soils may, therefore, be brought about, and without expense, by assisting Nature, in changing for the better both the chemical and physical character of soils, and by controlling the movements of the soil solutions. Efforts in this direction may be called "natural methods of improvement," because the aim is to assist Nature in her work which results in changing potential or possible into active, or actual fertility, rather than to add to the soil substances which contribute directly to the store of active constituents.

The Conservation of Moisture.

While the chemical and physical character of soils are of primary importance, and do in a large degree determine the possible productive power of soils, still the handling of the soil possessing these characteristics even in a high degree is of equal importance. That is, a soil however perfect as a place for the growth of plants, or however rich in the plant-food elements, cannot be productive without water, and the amount of water that plants may have at their disposal during periods of limited rainfall is measured in large degree by the methods of practice used. This point is of so much importance and has so intimate a bearing on soil improvement that it warrants a rather detailed discussion of the question of the conservation of soil moisture.

Water is one of the most important constituents of plants. If perfect growth and development are to be attained, it is necessary that the plant shall be able to obtain a full supply during its entire period of growth. It is not simply a question of water, however, for the water that plants use must exist in a special form in the soil, and it must exist there in proper amounts. Soils may contain too much or be too wet for the proper growth of the most useful plants, if the water is not located in the right place. Water exists in soils in three forms; first, free, or running water, or bottom water, or that which fills the soil, and rises and falls as it is increased or decreased by more or less percolating into it from the rains—the point to which it rises is called the water level; second, capillary water, or that held by the adhesion to the soil particles, and which fills the openings between the particles; and third, hygroscopic water, or that held firmly by the particles of soil. Land is too wet for growing plants if there is too much free or running water, or if the water level is near the surface, as it prevents the circulation of the air and the penetration of the roots to sufficient depths.

Plants do not, as a rule, use the running water; they are able to obtain all they need when land is moist rather than wet. For this reason the water in soils useful for plants is usually referred to as the moisture rather than the water of the soil. This moisture of the soil is really, therefore, the capillary water, or that held by adhesion to the soil particles, and while there may be too much capillary water in soils for the best development of plants, because certain kinds of soils may absorb too much, it is not usually a serious matter, because the difficulty can be readily remedied, as will be pointed out later.

The hygroscopic water is that which is very slow to escape, in fact, it must be driven out of the soil. That is, soil which appears to be absolutely dry may still contain this hygroscopic water, and in order that it may be perfectly dry, it must be driven out by heating the soil up to the temperature of boiling water for a considerable period of time—at this temperature (212 degrees Fahr.) the water vaporizes and escapes into the air. Naturally, this form of water in the soil is not a useful one for plants, as it exists in soils after plants have perished for lack of moisture.

Rainfall the Source of Soil Water.

The water in soils is due to the rainfall; the water-level in the earth rising in seasons of greatest rainfall, or wet periods, and falling in dry periods, hence, while the water that plants obtain is due to rainfall, it does not follow that it shall occur immediately preceding or during the season of the plant's growth. For example, there are places where the rainfall in the course of a year is so great as to provide such a total excess of water as to cause the soil to be thorougly saturated, or to keep the level so near the surface as to prevent the growth of plants, yet luxuriant crops are grown in these places. This is explained on the ground, first, that while the average rainfall is so great as to cause the soil to be thoroughly saturated, the time of the rainfall is such that during the crop-making season a sufficient amount only is provided for the plants; that is, that which falls during the season that crops are not growing partly sinks into the soil and partly runs off, and by the time the crop-season is ready, the water level is lowered sufficiently to enable the plants to throw their roots deeply, and they are fed with the capillary water drawn from the reservoirs below, which were filled by the preceding rains; and second, though the rainfall may be, on the average, too great, the soil is of such a character, open and porous, as to enable the rapid percolation of it to lower levels, and the climate such as to cause a rapid evaporation of it into the atmosphere. The moisture that may be obtained from rainfall is, therefore, influenced by two conditions, the time of its precipitation and the character of the soil upon which it falls.

An Even Distribution of Rainfall Desirable.

The water from the immediate rainfall to be most useful to plants should be distributed evenly throughout the growing season; in such cases, a minimum precipitation would provide for a maximum production, if the soil is of such a character as to retain and hold that which falls upon it for the use of the plants. Therefore, while rain is the primary source of water to plants, needed amounts may be obtained from underground supplies. That is, the season of rainfall may occur during the time when plants are not usually growing, but the water sinks into the soil which holds it as in a reservoir, and as the plants grow the moisture is gradually drawn to the surface by the influence of capillarity, and the amount necessary for full production is obtained, and while its original source is the rainfall, the immediate supply to the plant is derived from that which has fallen a considerable time previous to the period of growth of the plant.

Wet and Dry Seasons.

In countries and States where the year is divided in respect to rainfall into a rainy season and a dry season, the above considerations are well understood, and methods of practice which shall result in the conservation of moisture are of the greatest importance. In what are called the humid regions of the country, the crop does depend in many cases more largely upon the immediate rainfall than upon that which has fallen previously, and in these regions there are seasons when periods of drouth intervene, which make it necessary that a study should be made of the causes which contribute to the rapid escape of water from the soil, and thus make the supplies insufficient to furnish plants with what they need during the growing season.

The Loss of Water From Soils.

Water escapes from the soil by rising to the surface, where it is vaporized, absorbed by the atmosphere and carried away by the wind. The escape of water is, therefore, principally due to capillarity, for as the dry air passes over the surface of the earth, as well as circulating through the surface area, it absorbs all the moisture it comes in contact with; more moisture then rises from below to take its place, and so on until only the hygroscopic water is left in the surface, or within the reach of the roots.

It has been observed that all soils in the same climate do not become dry at the same rate. That is, one soil will remain wet, another reasonably moist, and another absolutely dry, as far as plant growth is concerned, and these in many cases may all be located on the same farm. These differences are due to the character of the soil, or the particles that constitute it, which have a greater or less power of retaining or holding fast to the moisture contained in it. Or, in other words, the character and texture of the soil influences the rate at which the water will escape. By character of the soil is meant its composition, both in reference to the minerals that are contained in it, as well as the size of the particles of which it is composed, or its texture.

A clay soil will hold water more tenaciously than a sandy soil. The clay soil is composed largely of a mineral known as silicate of alumina, capable of very fine division and close compaction; the sandy soil, on the other hand, is usually made up largely of quartz, a substance hard and stony, and not easily compacted. The clay, which is more finely divided and does not consist of stony particles, can be compacted so closely as to prevent the rapid escape of moisture, whereas the sandy cannot be readily compacted; it falls away again after pressure and the air and water circulate freely through it. As a broad, general rule, the finer the texture of a soil, the more retentive of moisture it is, and the coarser the texture the more readily will the water escape from it. In the first place, then, the greater or less retaining power of soils for water is due to their physical character, and in order to increase or decrease their retentive power their texture should be changed.

It must be remembered, however, that there is such a thing as a soil being too compact from the standpoint of moisture to plants, because this fineness and compactness prevent the ready penetration of the moisture into it; whereas, the open, porous soil permits its ready penetration, thus the one will, because of its compactness, result in the water flowing off rather than into it, and hence it will not always have as much moisture at a certain definite time after rainfall as the one which is more open and porous, and which permits a larger direct absorption and a ready percolation into the lower layers or reservoir below. Therefore, in the study of soil moisture in reference to the plant's needs, improvements of physical character are found to be of service, both in the humid and semi-humid districts, as well as in the arid or semi-arid, where irrigation is practiced; in the case of the easily compacted soil, to enable a greater absorption of that which falls and in the open, porous soil, to cause a greater retention of that which is absorbed.

The improvement of clay, or finely divided soil, should consist of such operations as will separate the particles, and make the soil more open and porous; this may be accomplished by the introduction into the soil of such substances as will coagulate, or bring together the fine particles, thus making the soil more porous. For example, liming a clay soil does improve its physical character and makes it more absorptive; it seems to have the power of collecting the very finely divided particles and partially cementing them into masses, and making the particles larger, thus making the openings between them greater, which permits a readier penetration into them of water and air. So, too, the introduction of vegetable matter, as coarse manures, influences and improves clay soils in this respect; the absorptive power of the soil is increased by the separation of the particles, not only, but because a substance has been introduced into the soil, which in itself has a greater absorbing power.

In the case of the sandy soil the same methods may be used, though the results are directly the opposite of those in the case of the clay. The addition of the lime, for example, has a tendency to cement together and to solidify the stony particles, thus closing up many of the pores and preventing the too rapid percolation of the moisture to lower levels, as well as its rapid escape, while the introduction of vegetable matter improves largely because the matter itself has a greater absorbing and retaining power than the mineral constituents of the original soil.

The aim, therefore, in both of the cases referred to is to get into and to hold in the soils of various kinds the water that falls in the rains, and conserve it for the plant during its entire period of growth. That is, all methods of improvement are based upon the principle that water that is most useful to the plant is absorbed or held by capillary attraction, and that its escape is due to the same cause or capillary attraction. Where water exists in soils in the running or free state, or in a form not useful to plants, where the water level is too near the surface, the improvement then must consist of operations which will lower its level in the soil so that an abundance of room may be provided for the distribution of the roots of the plants, and in order that the circulation of the air may not be impeded, drainage is necessary here, and will be discussed later.

Amount of Water Required by Plants.

The amount of moisture that is consumed by a growing plant is comparatively enormous, that is, the amount of water required for growing a crop is very great in proportion to the dry matter contained in it. On the average, in order to obtain one pound of dry matter in the crop, over 300 pounds of water will be required; that is, over 300 pounds of water must have been obtained by the roots and carried up through the plant and sent into the atmosphere from the leaf surface. Hence, some idea of the very great amount of water that is necessary for the growth of a large crop is gained. For example, a crop of hay from an acre of land, which contains a ton (2,000 pounds) of dry matter, would not be regarded as a large crop, yet in order to obtain it, there would be required over 300 tons (600,000 pounds) of water, and since plants vary in their needs, the maximum requirements for a pound of dry matter may be as great or greater than 600 pounds, or, in other words, large crops may draw as high as 2,000,000 pounds of water from an acre.

While the object in the conservation of soil moisture is to hold it for use of the crop, it must not be understood that all crops are equal in respect to their requirements. Crops differ widely in respect to their use of soil moisture, depending upon the kind of crop, the length of their period of growth and the object of their growth.

As a broad general rule, the broad-leaved plants and those which do not throw their roots deeply into the earth require more moisture in proportion to the dry matter contained in them than the finer-leaved plants, than those with less leaf surface and whose roots penetrate more deeply into the soil. For example, plants belonging to the grass family, as the grasses, useful for hay, and cereal grains, which do not present so large a leaf surface, and whose roots have a tendency to go deep into the earth, do not use up the moisture as rapidly as the legumes, or many of the vegetables, which have a larger leaf surface. The latter require the maximum amount of moisture in the soil, and suffer seriously immediately there is any lack.

While the total amount of water used may be the same for different plants, the time required for their growth and maturity must also be considered. A crop of wheat, for example, because it requires a longer season for full maturity may obtain its necessary moisture, though the soil contained too low a percentage to enable a potato crop, which grows and matures quickly, to obtain a full supply; a short drouth would not materially injure the wheat while it might ruin the potato crop, because of the difference in the length of the period occupied in the growth of two crops.

Where the object of the growth is succulence, and the leaf or root constitutes the crop, as in the case of many vegetables, as lettuce, beets, etc., an abundant and continuous supply of moisture is of greater relative importance than where the object is maturity, and the seed constitutes the crop, because any delay in growth in the former caused by lack of moisture is accompanied by a reduction in quality, as well as yield; whereas, in the case of wheat or other cereals the influence of delays in growth are more readily overcome, besides the yield rather than quality is affected. These considerations are useful in suggesting kinds of crops to grow under conditions of known rainfall.

A careful review of the principles here pointed out shows the importance of adopting and using methods that will aid as far as possible in retaining in the soil the moisture necessary for the growing plant; or in other words, to so direct it that it may pass through the plant into the atmosphere, rather than directly into it from the surface of the soil.

Conserving Moisture.

To do this, is called "conserving moisture," and many of the operations of the farm, which are now carelessly performed, which result in useless losses of moisture, may be changed so as to make them assist very materially in saving it for the use of the crop, and while the location of the soil, its character, its composition, its texture and the kind and character of crops all exert an influence, and while the principles as pointed out must be understood, the judgment of the farmer must be exercised in using the various methods that may be suggested, in order that they may apply to the best advantage in his particular case.

What is Meant by Tillage.

In the first place, tillage results in conserving moisture, that is, tillage, while ordinarily performed for the sake of getting the land in condition to receive the seed, and for the sake of removing or preventing the development of foreign growths, may be carried out in such a way as to accomplish not only these objects, the primary purpose in the minds of many, but also to accomplish great things in preventing useless loss of moisture, and thus result in providing the plants with their normal requirements. Tillage consists ordinarily in plowing, cultivating, harrowing and rolling, and each of these operations may be so directed as to needlessly waste soil moistuse, or to conserve it. Just how plowing has an influence in conserving soil moisture is readily understood when we remember that the moisture contained in the lower layers of the soil escapes at the surface of the soil by means of small holes or tubes formed by openings between the particles; in the process of plowing these openings or tubes are broken and the escape of the moisture from below, if not prevented altogether, is considerably retarded until sufficient time has elapsed to form the connection again with the surface. Therefore, it makes a great difference in plowing whether the furrow is thrown in a solid mass or whether when the furrow is turned the soil breaks into fine particles so that the entire surface is really a mass of separate soil particles. In the first case, the soil remaining solid the connection between the surface and the lower layers of soil is readily made, while in the second the loose mass of soil particles prevents a ready connection, considerable time must elapse before the capillary tubes join the surface with the lower layers. Naturally, the moisture contained in the soil turned by the plow will be liable to escape more rapidly than before, because the freshly turned surface is immediately presented to those natural agencies, namely, air and warmth, which are potent in drawing out and carrying it away. Nevertheless, the great reservoirs lying underneath are proof against these forces, in proportion as they are protected by the completeness or incompleteness of the soil mulch made in the process of plowing.

The Effect of Tillage.

In the next place, the moisture in the surface soil may be very largely retained if shortly after the plowing is done the cultivator and harrow are used to make still more fine the particles of earth thrown up by the plow, thus retaining in part that which would escape if the tillage were not practiced. Tillage, to conserve moisture, while confined to the cultivated crops, as corn and potatoes, does exert an influence also upon these crops, which by virtue of their character cannot be cultivated, as hay, wheat, etc., as well as upon the others, because previous tillage, viz: harrowing, plowing, etc., are operations which result in breaking up the particles of soil and thus making the surface soil itself a place where water will penetrate more readily and freely, as well as enabling the roots to ramify freely in every direction, and giving them a larger surface area from which to draw their moisture in times of drouth or in frequent rains. It is apparent, therefore, that tillage exerts an influence in conserving the moisture, not only for the immediate crop, but for future crops as well, because improving the soil in such a way as to make it more absorptive and retentive of the water which falls a considerable time previous to the planting of the crop.

The Object of Drainage.

In the next place, drainage is an important operation in improving the absorptive and retentive power of soils for water. A common idea is that drainage by lowering the water-table is only intended to remove the moisture that is present in too great amounts and that it does not exert any influence in providing moisture for crops during a period of insufficient rainfall. This idea is in part erroneous, for the very fact that the water-table is lowered enables a more rapid percolation of the water of the rains in every direction in the soil, than if the drains were not there, and as the water percolates and is absorbed more fully, the crops that follow have a larger area of moist surface to draw their water from than if the surface area of the soil through which the roots can penetrate was limited. Besides, the lowering of the water-table has a very important influence in improving the absorptive property of soils by virtue of the fact that it enables the penetration of the air to greater depths, which changes its physical and mechanical character, making heavy soils, particularly, more open and porous.

The Advantages of a Mulch.

Another method which is only practicable for small areas, is the use of a mulch, which may consist of any loose material spread over the soil and which acts as a blanket to prevent the rapid escape of moisture into the atmosphere. The principles involved in this case are quite similar to those described in the case of tillage and plowing. The water is prevented from escaping because the mulch distributed upon the surface soil prevents the immediate contact with it of the hot, dry winds; these affect first and directly the mulch itself, which protects and cools the surface. The use of mulches for small areas is very helpful, and while not practicable on large areas it can be made of practical value in gardens and orchards and for special purposes.

Growing crops are regarded as of use, also, in conserving moisture, though in a different way, particularly in the humid climates, since a soil well covered with a crop will absorb proportionately more of the rainfall than one lying bare, largely because it prevents surface drainage. Furthermore, the rapid escape of the water in the atmosphere is prevented because, as in the case of the other forms, the winds do not come in immediate contact with the soil, thus more of the moisture passes off through the crop rather than directly into the atmosphere. In the case of crop mulches grown as a catch for the primary purpose of covering the soil between the regular crops of the rotation there is a further advantage in that the vegetable matter accumulated by them is incorporated with the soil, which is materially improved because of the introduction into it of a substance which in itself, as already pointed out, has a higher absorptive power. This vegetable matter as it decays becomes what is known as "humis," a substance which exercises a very important influence upon the productive power of the soil.

Burning Straw a Wasteful Practice.

In many sections of our country, particularly in those States which possess soils rich in fertility elements, it is the custom to burn straw and other refuse vegetable matter. This is a bad practice, for even if it is not needed for improving the productive power of the soil in respect to other elements, if it is used as a mulch and incorporated with the soil it would assist very materially in retaining moisture for crops during the period of insufficient rainfall. If the straw is not needed for bedding and other purposes it should be distributed over the land, serving first as a mulch and then incorporated with the soil, thus improving its absorptive and retentive power.

The Effect of the Rolling.

Rolling the soil is another means by which moisture may be conserved, though the results of the use of this tool should be understood. Its best use is in the preparation of the soil for seeding by mashing lumps and clods, in solidifying it and making it fine and friable. If used after seeding, it compacts the soil and leaves the surface smooth, thus providing the very best conditions for the rapid movement of air over the surface and, therefore, causing the ready abstraction of the moisture from it. It should not be freely used on heavy clay soils that are often already sufficiently finely divided and which are liable to become too much compacted, even under natural conditions, but rather upon open soils, those that are of a loose nature, as sandy and gravelly, in order that the particles may be pressed closer together, and thus to prevent the rapid escape of the water. Nevertheless, in dry seasons the roller is useful at time of seeding, because the compacted surface and the greater evaporation therefrom cause a rapid drawing up of the water from the lower layers to the surface of the soil, enabling a quicker germination and a more rapid early growth. In other words, the rolling tends to draw the moisture from the lower layers to the surface layer, and its use can be recommended after seeding under the conditions named. The roller should be used during the preparation of the soil, and if used after seeding the surface should be again stirred by a harrow, which makes a light soil mulch, or after it has performed its function in making fine and friable the seed-bed.

In order to guide the farmer in respect to the application of the general principles here laid down, the following general suggestions are made.

When to Plow.

It has already been pointed out that plowing aids in the conservation of soil moisture. The question that naturally arises first, is what time shall plowing be performed in order to obtain the best results. It is obvious that for certain crops, as winter wheat or fall seeding of any sort plowing must be done in summer or early autumn, unless the land is fallowed, whereas for spring planted crops, as Indian corn, spring wheat, oats, barley and a number of others, it does not necessarily follow that plowing shall be done in the spring; fall plowing for these presents many advantages, though there are also disadvantages, and these must be carefully weighed before the practice is adopted. For example, the ideal condition of soil during winter is to have it occupied by a growing crop, because in this condition it readily absorbs and holds the moisture and prevents, in large measure, losses that occur through drainage from it of the soluble plant-food constituents, still the effect of freezing and thawing, and of oxidation, which take place when land is plowed in the fall, oftentimes results in a greater increase in immediate fertility than is accomplished by allowing the soil to remain in sod during the winter.

Soils Suffer Loss of Water When Bare.

In the case of lands that are not plowed in the fall, but which are allowed to lie bare during the fall and winter, they become hard and compact, particularly clay soils, and the rainfall is not absorbed but is lost, because of the rapid surface drainage. Hence, on account of the loss in the drains and streams, the season's rainfall, which with care might furnish sufficient moisture for a maximum production, is deficient and the crops suffer.

Fall plowing, by opening up and making more porous the surface soil, permits the ready penetration of water into it, as well as its percolation into the lower layers or subsoil, where it is held for the summer crop. In fall plowing no attempt should be made to thoroughly fine the surface, or to make it smooth, for this will encourage the soil to run together, or compact, particularly those of a clayey nature. Of course, this fall plowing applies more particularly to soils of a heavy character, or those which are compact or stubborn, rather than soils of good physical character. Fall plowing on sandy soils would not be of any particular advantage, as they do not compact, and rains penetrate readily during any season when land is not frozen.

If fall plowing cannot be accomplished, then the plowing should be done in early spring, in order that the capillary connection between the disturbed surface soil and the lower layers may be established before the spring rains cease, this, followed by deep cultivation and thorough pulverization of the surface previous to planting contribute materially to the conservation of moisture.

Deep plowing also contributes to the absorptive power of soils, and conservation of moisture, because providing for a much larger area of soil for the penetration of the roots, and if practiced in the fall, the best time to increase the depth, the inert material thrown up weathers during the winter, and the resulting chemical changes also improve the physical character, as well as increasing the active fertility of the soil. If the plowing is left until the late spring, then deep plowing is not so advantageous for many crops, as shallow plowing, for if there is sufficient rainfall in the early season the surface soil is soon dried and the roots of the young plants have not had time to penetrate deeply enough to take advantage of the reservoir of moisture lying underneath, whereas, if the plowing is shallow the roots soon reach through into the solid bed below, which contains the moisture, and the plant is enabled to resist more effectually any drouth which may follow.

Cultivation After Planting.

In order to retain the moisture after the crop has been planted, cultivation should be deep, early, and gradually lessened as the season advances, in order that in the early season the rainfall may penetrate to the lower layers, and in the later season the mulch provided by the cultivation may not be so deep as to enable the complete drying of the surface soil. The advantages of continuous cultivation are also marked, inasmuch as every time the soil is stirred the connection between the lower layers and the surface is broken and the water below must seek new outlets for escape; and until these are obtained the wāter is retained for the use of the plant.

The method of cultivation also should be observed. On soils naturally well drained, cultivation in ridges contributes to the loss rather than the conservation of moisture, as the ridges lying so much above the main surface of the soil dries out more rapidly than if level cultivation is practiced. Naturally, in wet climates it is frequently advantageous to ridge the soil, in order to provide for the rapid drainage of the water, but in soils where the need is for water rather than for lack of water, ridge culture is not advantageous.

Frequent tillage, or continuous cultivation, also tends to increase fertility, by causing a more rapid change of the insoluble constituents into soluble forms. The constant stirring of the soil brings new particles into contact with sun and air. In soils rich in dormant or locked-up food, this method of improvement, which results in increasing their direct fertility is strongly commended, since it can be accomplished without any outlay of cash and by the regular labor of the farm.

Further Methods of Improvement.

Soils may be further improved, namely, in two directions, first, by saving in the soil for the use of the plants those constituents which by improvident and irrational methods of practice are likely to be lost; and second, by adding to the soil such amendments as may increase the activity of the constituents already there, or which may contain such substances as are essential for the growth of plants.

Losses Due to Methods of Practice.

One of the means whereby soils may become impoverished, or at least be reduced in productivity, is through the losses that occur from improvident methods. For example, it has been demonstrated that plants obtain their food in a soluble form, and unless it is taken up when it has become soluble there is danger of its being carried away in the rains that pass through it. A saving, therefore, may be effected by keeping the land constantly occupied with growing crops, in order that food which is made available may be absorbed by the roots of plants and converted into organic forms which by their decay render it serviceable to other crops. The methods of practice quite common in the East require that the land lie bare at certain seasons of the year and some times for long periods, during which severe losses of plant food may occur, the chief element of which is the expensive constituent, nitrogen.

Experiments conducted by Sir John B. Lawes, at Rothamsted, England, showed that land in good condition, left bare from early fall until spring, would lose an equivalent of 37 pounds of nitrogen per acre. It was also shown that this could have been held and appropriated by crops. This loss of nitrogen may not seem a great matter at first glance, but a study of the losses in relation to crop production shows that it is really very serious. In the first place, this loss of nitrogen, which is possible and probable on good soils left bare, is more than equivalent to the amount contained in the average yield of wheat, rye, oats, corn or buckwheat; besides the nitrogen which is carried away by the drainage water, is in the very best form for feeding the plant, or it would not have been lost, and thus its absence leaves the soil not only poorer in this constituent element, but poorer in the sense that the remainder of it in the soil is in a less useful form. While the amount and time of rainfall cannot be controlled, its effect upon the soils in causing loss may be largely governed if proper attention is given to the matter of growing catch crops, in order that the land may be constantly occupied.

Another source of natural loss of nitrogen, is its escape as gas into the atmosphere, due to the oxidation of vegetable matter, which takes place very rapidly when soils rich in this substance are improperly managed. In the system of continuous cropping which is observed in certain sections of our country, the annual losses of nitrogen are much greater than the amounts carried off in crops, and while continuous cropping is not so generally practiced in the East the losses that occur, because of improper methods of rotation, which leave the land bare for any length of time, are very considerable. Indirect losses may occur, too, because the conditions are made unfavorable for the activities that are present in the soil. Take, for example, the rotation which allows the land to remain bare from the early part of July until September, when the rotation of corn, oats, wheat and grass is practiced. After the oat crop is removed in July the land is frequently allowed to lie uncovered, particularly in dry seasons, for a month or six weeks, during which time the weather is often very dry, usually very hot; the temperature of the soil is raised to the point which reduces the activity, if not destroying altogether the soil organisms, and because of the absence of these the changes that take place later are very materially reduced. Rotations should be adopted which will permit the continuous covering of the soil by regular crops, or such catch crops as will keep the land covered between the seeding of the different ones in the rotation. A discussion of the crops adapted for this purpose will be found in subsequent pages.

There are also losses of mineral elements, which may be prevented by keeping the ground covered by the growing crops. For example, lands that lie bare during the late fall, winter and spring are liable to be washed and gulleyed, and the finer particles on the surface carried either away from the land or to such points as to make it impossible to utilize them in the growth of crops. This loss may be avoided if the above suggestions are followed.

Improvement Due to Soil Amendments.

Another method of improvement, which is partly chemical and partly physical in its character, is the addition of lime. This can hardly be regarded as a natural method of improvement, because additions have been made to the soil of substances not before present; still it differs from the addition of manures or fertilizers, which contain the essential fertility constituents, nitrogen, phosphoric acid and potash, as the improvement is due, not so much to the direct action of the substances added as to their effect upon the substances already in the soil. That is, the function of the lime is to increase the active fertility of the soil by action upon the substances there, and thus causing a greater absorption by the plant of the nitrogen, phosphoric acid and potash already in the soil, and without adding thereto that which was not there before. The three main ways that lime may improve soils are: First, *by attacking the vegetable matter*, thus assisting in the change of the combined nitrogen into active, and by the reaction of the lime with certain phosphate and potash compounds, rendering them available to plants. This function of lime, however, is only largely valuable on soils already rich in vegetable matter and mineral constituents.

The second function of lime *is to change the physical character of the soil;* for example, on heavy clay soil, whose particles are finely divided, and whose texture is so dense and compact as to prevent the easy penetration and movement of water, the lime helps to coagulate the fine particles of the soil, thus making it more open and porous, and permitting the penetration and free circulation of air and water. While upon the sandy soils, which are too loose and open and texture, and which permits a too free movement of water, the effect of the lime is to cement the particles together and make the soil more compact, which increases its absorptive properties and a consequently greater retention in and utilization of the food in the soil by the plant.

The third function of lime, *is to neutralize any acid* that may be present in the soil, and which not only injuriously affects the growth of certain kinds of plants, but which is destructive to the life and growth of many of the lower organisms. Naturally this function of lime will be exerted whenever the lime is used for the other purposes mentioned, still there are cases where it would be desirable to use it only for this purpose, in which case the application may be much less. The advantage of lime in the growth of leguminous crops, for example, is not altogether because of the fact that this class of plants requires an abundance of lime, but because the lime exercises a favorable influence upon the physical character of a soil, besides making it neutral, and thus a better medium for the growth and development of the soil organisms, which have the power of gathering nitrogen from the air and which cannot thrive without air or in an acid medium.

The Importance of Vegetable Matter.

The lines of practice which have been suggested, in order both to prevent losses from soils and to improve their physical character, namely, the continuous cropping system, which holds fast to the available food in the soil, liable to be lost when the land is uncropped, and the addition of amendments which assist in making the necessary changes, also includes the further advantage of adding to the soil that which it did not before possess, viz: vegetable matter, or humus-forming material, which also improves the soil, not only in its absorptive properties for both moisture and plant food, but which contributes to the store of active essential constituents. The various crops that may be used to attain the first mentioned purpose, however, do not possess an equal value in this respect, and unless the principles which govern and the conditions under which they are grown, as well as the influence of the crops grown upon future productivity are well known the results obtained may not be always satisfactory.

Kind of Crops to Grow.

In the first place, the crops that may be used are divided into two distinct groups, in one group are included those plants which can obtain the necessary nitrogen for their growth only from soil sources and called "nitrogen consumers," and, therefore, when plowed down do not add to the soil any essential constituent element and are only serviceable in improving the physical character and absorptive properties of soils. The members of this group include the cereal grains, the grasses, buckwheat, turnips, rape, etc., yet, because of their time of growth and period of rapid development, it is often desirable to grow crops of this class, particularly where the primary purpose is to prevent losses of plant food rather than to rapidly build up the soil in nitrogenous organic substances.

The second group of crops includes those plants which belong to the legume or clover family, and which do not depend solely upon soil sources for their nitrogen, but can obtain it from the air, these in their growth and removal from the soil need not materially reduce the content of soil nitrogen, but rather particularly when plowed down directly add to the crop-producing capacity of soils by improving their physical character and by increasing their store of nitrogen. In order that a plant of this group may obtain its nitrogen from the air, however, the soil must contain originally, or must be inoculated with a specific organism, the presence of which in the soil is manifested by the growth of nodules upon their roots and through which it is believed the plants obtain their nitrogen, though the exact process is not yet fully understood.

Advantage of Legumes.

The use of this class of plants, therefore, possesses a three-fold value in the improvement of soils, first, in absorbing and retaining the soluble food in the soil; second, in providing vegetable matter, or humus-forming material, which contributes to the physical improvement of soils; and third, by adding to the store of nitrogen in the soil, the element most likely to be deficient, and which can be used by plants whose sole source of nitrogen is the soil. Fortunately, because of the number of plants belonging to this group, and because of their wide range of adaptation to the various conditions, it is possible to introduce one or more of them into the regular system of farm practice, without interfering with useful and profitable rotations. Many of them, for example, the various clovers, red, crimson and alsike, are already grown extensively, and their value in the rotation well understood by practical men. There are many others, however, whose characteristics have not been carefully studied until recent years, and whose usefulness are just beginning to be appreciated. Among these are the Canada field pea, the soy bean, the cow pea and the various varieties of vetch, all possessing that valuable power of appropriating for their use the free nitrogen of the air, and thus contributing directly to the potential fertility of the soil. The plants of this group are often called, and properly, "nitrogen gathering" crops, and their renovat-

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RYE.

ing and improving character are seldom over-estimated. A brief discussion of the various plants suitable as renovating crops, together with their characteristics and relative advantages must naturally precede specific directions as to their use.

Catch Crops, "Nitrogen Consumers."

The crop more generally used, primarily, to prevent losses during late fall and winter, is rye. The advantages of this crop for this purpose are that it may be seeded late in the year, after other crops have been harvested, grows rapidly, withstands the winter well, is a good forager, makes a rapid early growth, which may be plowed down for early crops as corn, potatoes, tomatoes, etc. Furthermore, the cost of seeding is small, and farmers are familiar with the handling of the crop. Its chief value, however, lies in its hardiness, withstanding well severe weather, and its habit of late fall and early spring growth, which holds the soil and prevents washing and mechanical losses; it readily absorbs the available food present in the soil, and even when plowed down early contributes in some degree to the humus-forming substances in the soil, and thus improves its absorptive properties.

Wheat possesses the characteristics which have been mentioned for rye, though not in the same degree. The seed usually costs more, and satisfactory growth requires a better preparation and fertilization of soil than for rye; besides, the plant is not so hardy and starts later in the spring. It is, therefore, as a rule, less satisfactory for the purpose than rye.

Buckwheat is another plant of this order, which has been used very largely as a soil improver, particularly in the breaking up of new lands, and for this purpose is a useful plant. Its season of growth is during the summer months of July and August, when conditions are usually favorable for the progress of those activities which cause changes in the soil substances, hence is able to make a relatively large growth on medium poor land; when grown as a renovating crop it improves the physical character of soils by keeping the soil covered during the hot season and by adding vegetable matter.

Certain varieties of the mustard plant are extensively used as a summer catch or fallow crop in other countries, particularly Germany; the plant grows rapidly and is able to subsist on rather poor soils, thus accumulating in the surface soil materials more readily appropriated by other plants. It, however, does not present any peculiar advantages for American conditions not possessed by the more familiar crops grown here.

The turnip also possesses characteristics of value, owing to its rapid appropriation of food in cool weather and consequent large growth during the late fall. These varieties which root deeply are preferable, because they gather a portion of their food from lower layers of soil and store it in their enlarged bulbous roots, near the surface; besides this peculiarity, the growth of the crop is an important factor, as it exerts a favorable influence upon the physical character of the soil. It causes a separation of the soil particles and permits a freer access of air. The disadvantages of the crop is that it dies at the beginning of winter. Still, if a considerable crop is grown, the mulch, consisting of roots and leaves, will hold the soil together, besides preventing as rapid a leaching as if the soil were entirely exposed.

Dwarf Essex rape is another plant that may be grown as a cover in the late fall and to serve as a mulch during the winter, and for these objects serves an admirable purpose, though possessing the disadvantages mentioned for the turnip.

All of the crops here mentioned may be made virtually catch crops and thus not interfering with a regular rotation, and even if pastured or completely removed they leave the soil in a better condition than if no crop had been grown; the soil is improved, because its functions have been exercised and at a minimum expense.

Catch Crops, "Nitrogen Gatherers."

Of the "nitrogen gatherers," the clovers as a class are perhaps the best known, though it is believed that a brief description of the characteristics of the various useful plants belonging to this group will be helpful.

Red Clover.

The renovating character of a crop of red clover is well known, and even when only the stubble and roots are the source of the additions made to the soil, the improvement which follows is very marked. Farmers know that corn or wheat seeded on a clover sod will do much better than when seeded on raw ground or on sod from grasses. It is ordinarily a biennial though sometimes the life will continue through three seasons. Its characteristics are such as to make it adapted to a wide range of soils and of climatic conditions, though it thrives best on good soils, well supplied with humus. It is liable to be uprooted on wet soils by the alternate freezing and thawing in spring, and to be destroyed by hot weather on light sandy soils. The amount of seed to be used when the purpose is to secure the largest crop of clover is about 12 to 16 pounds per acre, depending on the character of the soil, the better the soil the less the amount of seed required.

CRIMSON CLOVER.

The ameliorating influence of this crop upon soils is due primarily to two causes, first, to the extensive root system, which is distributed widely throughout the soil, and to great depths in it, thus changing to some extent its physical character, as well as the storing up of food in a large tap-root near the surface of the soil, in organic forms, which readily decay; and second, because the plant is a "nitrogen gatherer," the crops of clover removed do not exhaust the soil of nitrogen, but rather add to its store, hence the succeeding crops have at their disposal a larger amount of this element than if they were preceded by the grasses or cereals, which are "nitrogen consumers." The wider and more frequent use of red clover can be commended from all standpoints, where the increase in and the maintenance of natural fertility are important, and in general farming these points are always important.

Mammoth clover is a near relative of the red variety and resembles it closely. It is a coarser plant and a greater forager; where clover is grown solely for use as a green manure the Mammoth may often be substituted with advantage for the red. It is also better adapted for wet lands than the red. The amount of seed used may be the same as for red clover.

Alsike Clover.

Alsike clover is believed to be a cross between the red and white clovers. It has a semi-creeping habit like the white variety and only does well when seeded with a variety making a more upright growth, as the red or Mammoth. The mixture is desirable, since the alsike is better adapted for cold, moist soils and is also hardier than the others, withstanding winters that kill the red and Mammoth varieties. A good practice in growing these varieties of clover with the cereals is to sow early in spring on the wheat or rye, seeded in the fall, and at which time timothy has been seeded, at the rate of 8 to 10 pounds per acre; the usual mixture of alsike and red is two pounds of the former to eight of the latter, using about eight pounds per acre. The seed of the alsike is so much smaller than the red that seeding in these proportions results in a very even mixture of the clovers. The seeding may, however, be made with advantage during the summer and early fall, without cover crop, either for turning under in spring as green manure or for hay or pasture. Such seeding should be made on soil well prepared and the seed lightly covered.

Crimson Clover.

Crimson clover is an annual, and because of its useful characteristics has made a place for itself in American agricultural practice.

Its habits of growth are not so well known as those of the other varieties described and for this reason, among others, is not so generally distributed even in those sections where it thrives well. Its habits are such as to make it undesirable to substitute it for the red, though it may well supplement it, and thus add another useful clover crop to our list. It is essentially a cool weather plant, thriving well in late fall and eary spring, and maturing seed in the middle States about June 1st. These characteristics of growth make it especially suitable for a catch crop, which may be used without interfering with regular rotations. It has proved hardy in the eastern and middle States, though many failures are reported, which are probably due in large part to the failure to observe in its seeding the peculiar habits and characteristics of the plant. The impression that because it is a catch crop it will grow well on poor soils with other crops, under all conditions of season and climate and without particular care in seeding, is erroneous. Like other plants, crimson clover must have food—it is affected by drouth and cold and severe weather; it cannot subsist with other crops, which rob it of moisture and plant food, and it must be carefully seeded, in order to insure against adverse conditions, though when conditions are favorable it will catch and grow from a simple sowing of the seed on raw ground. It should preferably be seeded at the rate of 12 to 15 pounds per acre, on a well prepared seed-bed and covered lightly with harrow or weeder. It is not suited for spring seeding, as it ceases to grow as soon as hot weather comes, the best period for seeding ranges in the eastern and middle States from July 15th to September 1st; it may, therefore, be used as a catch crop, seeded in corn, berry patches, orchards, etc., after the regular cultivation has ceased for the season and after early potatoes, tomatoes and other crops harvested early enough in the season to enable its roots to get a hold of the soil and to make considerable top before cold weather sets in. While it requires a good soil for its best development it is well adapted for light sandy soils if well supplied with mineral food. It will grow later in the fall than red clover, because not injured by frost, and also make a more rapid spring growth than any of the other clovers seeded in the late summer. Where the land is light and poor, a dressing of acid phosphate, say at the rate of 150 pounds per acre, will materially aid in securing a catch and insuring a crop. Its early maturity is one of its most valuable characteristics from the standpoint of its use as green manure, making it possible when seeded in corn, for example, to secure a considerable green manure crop, in time to plow down for another corn crop. When the plants are largely destroyed because of severe winters, the accumulated nitrogen and organic matter in the fall is sufficient to amply repay the cost of seed and seeding. Studies made at the New Jersey Experiment Station show that a good thick crop, six inches high, will contain nitrogen and organic matter equivalent to that contained in five tons of yard manure; that the nitrogen is quite as useful for the corn plant as that contained in the manure, besides it is evenly distributed and there is no labor involved in its application. Another advantage of the crimson clover is that it is a spring green manure crop, thus permitting a return from it in the same season in which it is used. It will pay farmers to carefully study the habits of this plant and then to introduce it in their rotations as a soil renovator. If failures occur the cause should be learned and a remedy sought; discouragement should not follow one or two failures; remember that red clover sometimes fails. It has succeeded in many instances when red clover has failed.

Other Varieties of Clover Sometimes Used.

There are various other varieties of clover which possess useful characteristics, though with the possible exception of sweet clover, which is sometimes used in the south, they do not possess advantages superior to those varieties already mentioned. The sweet clover (*Melilotus Alba*), is a rank growing plant and is quite common as a weed along roadsides and in waste places. It is seldom cultivated, either for forage or green manure, though it seems to have the power of acquiring food from sources inaccessible to other plants of the same family. It thrives particularly well on soils rich in lime. Experiments with it in Alabama, Mississippi and Ohio show that it in common with other legumes aids in soil improvement. Its use is recommended only where other varieties do not meet the requirements.

Alfalfa.

Alfalfa belongs to the clover family and while one of the most valuable of this class of plants, from the forage standpoint, is not adapted for use as a green manure, because of the difficulty of securing a stand, and because of its comparatively slow early growth. It is a perennial, which does not reach its maximum annual growth until the second or third year after seeding.

The Field Pea.

The field pea, the variety that is used for forage, for cover crop or for green manuring, is usually known as the Canada field pea, though the name includes a number of varieties, as the Golden Vine, Prussian Blue, Green Field, Mummy, etc., any one of which is satisfactory for the different purposes. This field pea does not differ in appearance nor characteristics from the ordinary garden pea. It thrives well in the more northern States, only in the cool moist weather of early spring and late fall, and for this reason is not adapted to sections south of the middle States, and its use as a cover crop, or for green manure is limited for this reason, as well as to the fact that it does not grow well except on good soils. Still, there are occasions when its use will meet conditions not provided for so well by other plants. For example, it may be seeded in September, or even early October, periods too late for the seeding of other legumes, and because of its rapid growth makes a crop before freezing weather; the crop serving as a mulch during the winter, preventing the wasting of sandy soils due to high winds, and the accumulated nitrogen and organic matter provide readily available plant food for spring sown crops. It has proved of great advantage in many lines of farming, where the crops are not removed early enough to permit the seeding of crimson clover, or other leguminous crop. It should be seeded at the earliest possible time in spring, and in fall, not earlier than September 1st, at the rate of one-half to two bushels per acre, and the seed well covered, preferably two to four inches.

Cow Peas.

The cow pea is probably neither a pea or a bean, as it differs widely from both, still it belongs to the same family, as do the clovers and field peas. Its origin is authoritatively stated to be the east, where it has been cultivated for thousands of years; it is believed to have been introduced into this country in the early part of the eighteenth century. Its best development is found in warm climates, hence in this country it has found a congenial home in the southern States, where it reaches its maximum development. A large number of varieties have, however, been developed which are adapted to cooler conditions, so that now it is well distributed even throughout the north, where it is proving itself one of the best annuals, and its adaptation to various uses and the rapid and large development of plant, make it one of the most useful of the legumes for soil improvement.

Varieties.

The natural tendency of the plant toward variation has resulted in a large number of varieties, though the permanent and distinct ones are comparatively few; the same variety is given a different name in different parts of the country, as, for example, one variety goes under the name of Unknown, Wonderful and Quadroon. In addition to the confusion arising from this practice. The selection of a variety is still further complicated by giving the same name to

COW PEAS.

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a number of varieties, as, for example, the name of Crowder is applied to any variety in which the seeds are closely packed together or crowded. The further fact that the season and climate exert such an influence upon the plant as to make a variety in one place very different in its character than in another, makes it difficult to give positive advice as to the selection of varieties for specific purposes. The different varieties range in form from a bush a foot or so high, without runners, to those possessing vining or trailing habits, the vines reaching a length of from ten to twenty feet long, according to soil and season. The pods also range from four to eighteen inches in length, giving seed of every possible shape and form. The period of mature growth also varies, as do the habits of growth. The different varieties ranging in their time of maturity from two to six months, though the habit of growth does bear some relation as to the time required; the smaller the plant and the more nearly it approaches the bush form the shorter the time required for maturity, while the more rapid the growth and the larger and longer the vines the longer the time required. In order to select the proper variety for the various purposes, the object of its growth should be clearly understood. Where short, quick growth and maturity are required then, particularly in the north, the bush variety should be selected; whereas, if the purpose is for forage, and the period of growth can be extended, then the vining varieties are likely to be more useful.

In cases where they are grown primarily for green manures, then the time during which they grow should determine the variety to select. It is more difficult to select varieties for the north than for the south, as the plant has not been so carefully studied in this section. Nevertheless, the Early Black, Whippoorwill, Wonderful and Clay varieties have proved excellent for the various purposes. The Early Black, where the seed crop is desired, as it grows and matures quickly, whereas the others are better adapted for forage and green manure, as the longer they grow the larger the crop of succulent forage in one case, and of total crop in the other, except in the case of green manures, when only two or three months can be given to the growth of the crop.

Method and Time of Sowing.

The time of seeding the cow pea will depend upon the character of the weather; they should not be seeded in spring until danger of frost is past and the soil is thoroughly warm. In cold, backward springs many failures have been recorded, because of too early seeding; the seed are liable to rot in cold weather, and if germination takes place the plant is retarded in growth in cool weather and the crop is unsatisfactory even if warm weather follows. This is of particular importance where they are seeded for forage or hay, as very often crops are failures because the seeding was so early as to cause the weather to injure the plant, and thus prevent its early growth. Neither should they be seeded later than two months before the average date of frost, as the first heavy frost will destroy the young plants and no variety that is now known will reach a satisfactory stage of growth for any purpose inside of this period. For forage and for green manure the crop may be sown broadcast at the rate of from one to one and one-half bushels per acre, or may be drilled in with an ordinary grain drill. If the seeding is not made too early, broadcast methods are very satisfactory. If, however, the early growth of the plant is retarded then weeds obtain a foothold and it is likely to be choked out.

Where the object of growing the crop is for seed, then planting should be preferably in drills, from two to three feet apart, or a little closer than for corn, and the amount of seed may be reduced to three pecks per acre. Seed should be covered from one to two inches deep and on very light soils a little deeper. The season to some extent governs the depth at which seed should be planted—in a dry season the deeper the seed the better. The difficulty in late summer seeding is that crab-grass is liable to choke out the plants.

There is perhaps no other crop that is so generally useful for soil improvement as the cow pea. In the first place it grows during the hot summer, when it is desirable to have the ground covered and its long tap-root penetrates into the subsoil, loosening it and making it more porous; and in the second place, the absorption and assimilation of the free nitrogen in the air by this crop, which is characteristic of all the legumes, makes it one of great service, even when the crop is used for forage and only the roots and stubble are left as additions to the soil.

In using the cow pea it may be plowed under while green, or may be left on the surface as a mulch during the winter, and plowed under in the spring. It may be partially grazed and the stubble and roots plowed under, and in any case the improvement of the soil is very marked. Where the forage can be used to advantage and the object is to gradually improve the soil, then the better plan is to remove it either for use as green forage or for hay, as on good soils the stubble and roots left will furnish sufficient nitrogen to supply the early needs of a cereal crop. On light soils it is also desirable to remove part of the growth, as the turning under of a too heavy crop of cow peas would be likely to injure rather than to improve the physical character of the soil. The danger from plowing under heavy crops of green manure is not so marked in the north as

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SOY BEANS.

in the south, where the temperature range is high for a longer period. On heavy clay soils the improvement in plowing under heavy crops is very marked.

Soy Bean.

The soy bean has a strong central root, stiff stems, broad leaves and somewhat resembles the ordinary bean, though it is larger and bushier in form. The plants may be dwarf and early maturing, or late and tall, though in no case do they vine as do the vining and trailing varieties of cow peas. There are a number of varieties—the Green seems to be the variety most generally used and the crop from it varies according to the season and climate. This plant resembles the cow pea in many of its characteristics, namely, that it should not be seeded until the soil is warm, and where grown for forage it should be preferably planted in rows, in order that it may be cultivated. For green manuring purposes it may be seeded broadcast. The amount of seed per acre will vary from one to one and one-half bushels when broadcast, depending upon how well the seed are covered; when seeded in rows the amount of seed may be reduced to one-half bushel, or three pecks, per acre. The land should be put in good condition, in order that germination may be prompt. It does not possess, for green manure purposes, any characteristics different from those mentioned for cow peas. In fact, experience thus far shows that the soy bean is slightly more difficult to handle, and the yields are not so heavy, though the plant contains more nitrogen in the dry matter than the cow pea. It has been grown for green manure purposes when there has been a scarcity of the seed of the cow pea, and many prefer it to the cow pea, because it is easier to completely cover the plant in plowing, whereas a large crop of cow peas is particularly difficult to plow under. The decay of the plant will probably be quite as rapid as the cow pea, and hence serve quite as well as a source of nitrogen to the cereals.

Velvet Bean.

The velvet bean has attracted a great deal of attention lately in the southern States. It originated in the tropics, and has proved successful only in the southern States. In Florida it has been one of the most useful of the forage plants and is highly regarded as a green manure crop. It grows well on light, sandy soil and the yield is ordinarily about the same as for the cow pea. The season of growth is much longer, and for that reason the seed cannot be matured except in the south. The results of experiments conducted in the middle and eastern States show that it is not well adapted for these sections, and does not make as satisfactory a crop for any purpose as the cow pea.

Sand, or Winter Vetch.

This vetch is an annual, and is a native of western Asia. It has been recently grown wih success in the middle, eastern and southern States. It is a trailing plant, thus making it difficult to harvest for forage, unless seeded with some small grain, as wheat, oats or rye, to serve as a support. It may be planted either in spring or fall, at the rate of about one and one-half to two bushels per acre. It grows much better upon light, poor soils than cow peas or soy beans, and for such conditions is much superior as a green manure crop. The cost of seed thus far has practically prohibited its use, except in cases where small areas are grown.

Soil Inoculation.

The superior advantages of the leguminous crops as green manures, are due in large part to the fact, as already pointed out, that they are capable of obtaining their nitrogen in part, at least, from the air, a source inaccessible to the other class of plants. It must be remembered, however, that in order that this function may be exercised it is necessary that there shall be present in the soil certain organisms which attach themselves to the roots of the plants; their presence in the soil is indicated by the formation of tubercles or nodules on the roots, which range from a pin-head to a pea in size. Where these nodules are not present on the roots it is an indication that the proper organisms are not present and that the legumes, in common with other plants, must derive their nitrogen from the soil, and thus from the standpoint of accumulation of nitrogen they are, under these conditions, no more useful than the cereal crops.

Methods of Inoculation.

In view of these facts it becomes necessary in order to obtain the full benefit from the growth of the leguminous crops, to see to it that the proper organisms are present in the soil. This may be readily accomplished by inoculation, or introducing the specific organism into the soil. That is, soils in which these organisms are not present may be supplied with them by using a portion of the soil where they are present to introduce them. Experiments that have been conducted show that a small quantity only is necessary to accomplish the purpose, for example, a peck or one-half bushel of soil taken from different parts of a field which contains the organisms will, if sown broadcast over an acre which does not contain them, introduce the organisms, which multiply and distribute rapidly, and be prepared to do their work for the crop. Once the organisms are present in the soil there is but little danger that they will be destroyed under good conditions of practice, and if the crops that are grown upon the area which has been inoculated are used as food for farm stock and the manure used elsewhere upon the farm the chances are that the organisms will be generally distributed, so that the work of inoculation is not a serious matter.

It very often happens that in the growing of such crops as cow peas and soy beans the first crop grown will not show the tubercles on the roots, but that the second one grown will be well supplied with them, indicating that the organisms are very often introduced into the soil by means of the seed, and seedsmen in some cases now make it a practice in harvesting their crops of soy beans and cow peas to pull them instead of cutting them, thus in threshing, mingling more or less of the soil which contains the proper organisms with the seed and which when removed leave the seed well inoculated.

The Amount of Nitrogen Gathered.

It does not follow, however, that even when these organisms are not present in the soil that all of the nitrogen contained in the crop of the legume grown has been gathered from the air, as it has been shown that the plants would preferably take soil nitrogen, and, therefore, that on good soils, well supplied with nitrogen, the proportionate amount of nitrogen drawn from the air will be much less than that will be the case when the crop is grown on soils poor in nitrogen. The exact amount of nitrogen gathered by a crop cannot, therefore, be exactly determined, though it is believed to depend upon the character of the soil, whether rich or poor in available nitrogen, hence the usefulness of the legumes as a means of acquiring nitrogen is greater when grown upon soils poor in this substance; these soils are, however, more greatly benefited by the accumulation than those previously rich in the element nitrogen.

The Importance of an Abundance of the Mineral Elements.

It has also been pretty clearly demonstrated that the proportion of nitrogen gathered by the plant from the air, particularly upon poor soils will depend upon the supply in the soil of the other necessary plant food ingredients. That is, soils poor in nitrogen and oftentimes poor in physical character if not well supplied with the minerals, phosphoric acid and potash, will not produce a large crop of cow peas or soy beans, or any other leguminous plant, because its grows and development depends upon the ease with which it may acquire the necessary amounts of the other elements of nutrition. Hence, in attempts to build up poor soils by means of green manure crops it is quite as necessary to fertilize with the minerals, in order to insure maximum growth, as it would be in order to grow any other crop, the purpose of which is the crop itself, rather than for its effect in soil improvement. This is entirely reasonable, as the mineral constituents cannot be attained from any other source than the soil, and they are quite as essential in the complete growth and development of a crop as is the nitrogen.

The point is, that green manuring does not result in building up and making better a soil that is naturally poor in the mineral constituents. It can only contribute the nitrogen, and that in itself is not a complete food, it is only one of the essential, though very important elements. On heavier soils, overlying strong subsoils, as, for example, clay loams, and which are usually rich in dormant mineral constituents, the practice of growing the legumes may result in building up the soil, both in available nitrogen and in available minerals, as these plants have the power of acquiring the minerals from such soils more readily than certain other classes of plants, and thus by their growth there is an accumulation of nitrogen, as well as an accumulation of the mineral elements in a more available state, and the soil is improved in all directions without the direct addition of any fertilizing substance. The roots running deeply in the soil and subsoil gather the mineral food and store it in their larger roots near the surface, where it is not only available from the standpoint of other plants reaching it, but available from the standpoint of its being more readily acquired by them. Such soils may be improved and kept in a high state of fertility by the frequent growth of a renovating crop, whereas, on light soils which are poor in all constituents, the improvement will be in proportion to the amount of minerals supplied, as they will measure in a degree, at least, the rate of appropriation of the nitrogen. These considerations are practically true for all of the plants in the group of legumes that has been considered, though the different plants may apparently differ materially in their rapidity or degree of growth, even on the same soil and without the addition of other materials. The fact remains, however, that genuine improvement of poor soils cannot be expected from the growth and use of green manure crops alone.

The Plowing in of Green Manures.

Another point that should be clearly understood in the matter of soil improvement by means of green manures is the time for plowing down the crop. In the first place, the character of soil exerts an influence on this point. As a broad, general rule, there is danger of injury to light soils in plowing down a heavy burden of green material, particularly in warm weather, whereas upon heavy soils the danger is very much less, and in fact ordinarily quite remote. Hence, in the discussion of the subject the influence of the season of growth of the plants is worthy of consideration. If the crop which is intended for green manure matures rather early in spring, then the time of plowing under must be governed by the purpose of the growth of the crop which follows, as its development will be materially influenced by the operation. Take, for example, rye, representing the class of "nitrogen consumers." This crop makes a rapid, early development, and if allowed to entirely mature it not only draws heavily upon the available food constituents of the surface soil, but rapidly and often completely exhausts it of moisture. Hence, if plowed down in its mature state it will result in leaving a mass of vegetable matter not readily decayed between the surface and the subsoil, thus cutting off absolutely the connection between the surface and the reservoir of water lying below. Should, therefore, dry weather follow, the decay will be very slow and the succeeding crop will have only the food and the moisture that are contained in the surface soil turned over, and from this the available food and the moisture have been largely extracted by the maturing of the large crop of rye.

Spring Green Manure Crops.

Hence, it is readily seen that the time of plowing down the green crop is a matter of the very greatest importance. Rye is an excellent green manure, if properly used. It should, therefore, be plowed down not later than when just coming into head, when the vegetable matter is immature, which readily breaks down and decays, and when the smaller growth of the plant has made but little demand upon the soil for moisture. Furthermore, in this early stage of growth the vegetable matter does not make so bulky a mass between the surface and subsoil, and thus the capillary connections between the upper and lower layers are readily made, and hence not preventing the next crop from securing its needed moisture.

The principles involved here are practically the same for crops of a leguminous character. For example, crimson clover, which has been seeded in corn, or that has been seeded in orchards for the purpose of accumulating nitrogen, also prevents mechanical losses and contributes to the improvement of the physical character of the soil. Still, the time of plowing down the crop is of the very greatest importance, not only in its influence upon the character of the soil itself, but upon the growth of the subsequent crop. Should the crop mature, and the weather conditions be entirely favorable, and there is sufficient moisture and warmth, then no danger may be apprehended in allowing it to mature, but if the primary purpose is not to secure the full benefit of the clover crop, but rather to ensure the growth of the succeeding crop, whether it be corn or peaches, pears, plums, etc., then the use of the crop, its time of plowing down, should be made when it will not interfere with the primary purpose in its growth.

Fall Green Manure Crops.

In the case of crops that are grown during the summer the considerations in reference to soil still hold true, and even in a greater degree, since crops plowed down during the summer are more liable to rapid fermentation than those plowed down in the spring. Trouble from soil acidity may result from plowing down in the late summer or fall crops grown in the summer, still, the results of such practice will depend considerably upon the time that they are turned down and the character of the weather which follows. Cow peas, for example, that have been seeded in July and have grown through August and September may be plowed down in October without any danger to the succeeding crop or soil, unless the weather conditions are very unfavorable, as, for example, dry and hot, in which case the dangers pointed out in the turning down of the rye in the spring in its mature state would be likely to follow. Otherwise, if the weather should continue moist and hot, the rapid decay of the vegetable matter would be likely to result in a too rapid fermentation, probably inducing acidity of soil; this would not be likely to be a real danger except upon very light, open soils. On heavy clay soils, where the texture is more dense the tendency would be to prevent the too rapid entrance of air, and thus cause a more uniform decay.

When to Lime.

Where the crop is very large and where the conditions pointed out here are anticipated, the better practice will be to remove in part at least the burden of crop. It is desirable, also whether in the spring or fall use of the manure crops, to see to it that there is sufficient lime in the soil to assist in the fermentation, as well as to neutralize acids that may be developed. Hence, where green manuring is practiced, there is greater need of the occasional application of lime. It is not necessary that it shall be applied in all cases, since the application of, say 25 bushels of stone-lime per acre, in a rotation once in four years, would be likely to meet all the needed requirements for lime. If these suggestions are observed in reference both to soil inoculation and the plowing in of the green crops, there is no question as to the advantages that may be derived from the practice. It will result, not only in building up soils poor in that important element, nitrogen, but will contribute materially to the improvement of their physical character, the water-holding capacity, and their consequent crop-producing power. On soils rich in potential fertility, the continued and judicious use of green manures will materially improve the mechanical character of the soil, not only, but will be very influential in the maintenance of fertility, without large additions of the minerals, phosphoric acid and potash.

The Amount of Nitrogen Contained in Average Crops.

While it has already been pointed out that it is very difficult to estimate the amount of nitrogen that the leguminous crops will draw from the air, the following tabulation shows the nitrogen and organic matter that are contained in an ordinary crop of the various plants:

	Tons Per Acre Green.	Nitrogen. Lbs.	Organic Matter. Lbs.
Cow peas, ...	6	48	1,920
Soy beans, ...	6	60	2,640
Crimson clover, ...	6	60	2,160
Alsike clover, ...	6	60	2,640
Red clover, ...	6	60	2,400
Canada field peas, ...	5	50	2,200

If the amounts of nitrogen indicated in the table as contained in a crop that can be harvested were all gathered from the air, there would be an undoubted increase in the fertility of the soil, as the amount of nitrogen gathered is equivalent to that contained in from 320 to 400 pounds of nitrate of soda, which amount would be regarded as a heavy dressing for even vegetable crops. Interpreted in terms of yard manure, the nitrogen and vegetable matter would be equivalent to from six to eight tons of average yard manure. It must be remembered too, that the yields given are not large, and that they do not include the amount of nitrogen and organic matter that may be contained in the roots and stubble, which in the case of the clovers is very considerable.

Furthermore, experiments have shown that the rapidity with which the organic matter will decay and give up its nitrogen to the cereal group of plants, is such as to make this source of nitrogen compare favorably with that contained in the average commercial fertilizer. The fact that so large an amount of nitrogen is introduced by means of green manures, whether entirely drawn from the air or not, makes it important to use care, in order to prevent too large accumulations of this element. The danger, particularly in the case of certain cereal crops and fruits, is that the excess of nitrogen would be likely to cause an abnormal growth, that is, an undue leaf and wood growth. As in all other lines of farm practice, it is the judicious use of nitrogen that results in maximum returns.

Practical Application of Principles.

In order to give the most practical information to the farmer, the discussion of the use of the various plants described will be considered, first, in reference to those grown for the primary object of preventing losses in soils, and their consequent indirect improvement, due both to the saving of valuable soil constituents, and to the addition of vegetable matter; and second, in which the object of use is primarily to build up wornout or run-down soils, both in their physical character and their nitrogen content. In order that the matter presented may be directly applicable in present practice, it is necessary to select a method of practice now largely followed and which if continued will result in loss, and point out how the plants may be used and losses may be prevented, and what the gains are likely to be other than the saving of the food in the soil.

The Losses that May Occur in Rotation.

The common rotation of corn, oats, wheat or rye, and clover, may be taken as an example, because as usually conducted it is wasteful of fertility, due to the fact that no improving crops are introduced between the cereals, and only one in the rotation, and if the clover fails there is no renovating crop grown. By this practice it is impossible to prevent losses due to leaching, since the land is left bare for a part of two years. The sod land is used for corn, if it happens to be clover, the striking benefit of the clover in furnishing an abundance of nitrogen is apparent. The corn crop is usually harvested in early September, at a time in the season when, because of favorable conditions of weather preceding, namely, warm and moist, there has been an accumulation in the soil of nitrates due to the breaking down of the vegetable matter contained in the clover crop. After the removal of the corn, the land is left bare, except possibly a few annual weeds, the nitrates that have been formed and are ready to immediately feed another crop, and which are freely movable are carried away into the drains by the heavy rains liable to come in the fall. If heavy rains do not come in the fall, then the spring rains, which come before another crop is planted, carry at least a part of the nitrates so essential for the nourishment of the early seeded crop away from the soil. The further disadvantage is that with the soil bare during this period of five or six months, the mechanical losses due to the high winds of winter and spring and to the washing of the surface are very considerable, especially on light land.

The losses that have resulted because of these conditions leave the soil depleted of a part of its active constituents, hence when the oats are seeded in the spring the crop may start promptly, due to the nourishment contained in the seed, but this consumed, the young plants soon become hungry for food, the available nitrogen, which is necessary for a rapid growth is lacking and it does not make proper development until the conditions of warmth and moisture are again favorable for causing changes to take place in the soil, unless directly fertilized or manured. After the oat crop is removed, usually about the middle of July, the land lies bare again until the seeding of wheat or rye in September. During the summer season, the losses from leaching are not likely to be so serious, except in seasons of unusual rainfall, but if not wet, the weather is usually very hot; the rays of the sun strike direct into the soil and the temperature, particularly if it is sandy, rises very high—the soil becomes dry and hot, in which case the organic life present in the soil is likely to be destroyed. That is, because of the high temperature at this season the soils are not improved by lying bare, but rather injured, and when the fall crop is sown, instead of an accumulation of available food in the soil, for the wheat or rye, there is a deficiency, because the agencies active in promoting changes of dormant into active foods have been in part destroyed. The succeeding year crops must, therefore, be fertilized to ensure a good start, and a sufficient root-hold upon the soil to carry them through the winter. These, in brief, are the unfavorable conditions in a rotation of this sort, a rotation in many ways a desirable one, but which as ordinarily conducted results in a rapid exhaustion of soil, though one which permits of great improvement if properly modified by the use of catch crops.

The Use of Catch Crops Improves the Rotation.

In order to prevent losses, as well as to provide for an accumulation of food in the soil, the following suggestions are made: In the first place, crimson clover may be seeded in the corn, just before the last shallow cultivation, at the rate of 12 pounds per acre. If the seed is well covered it will germinate very quickly, though the plants may not make much growth until after the corn is removed, owing to the rapid absorption of food and moisture by the corn in the last stages of maturity. The plants will, however, then start up and grow rapidly and if the weather is favorable often cover the ground with a mat six or eight inches thick, filling the entire surface soil with fine rootlets, which absorb and hold fast to the available nitrogen already there, and which would otherwise be lost, besides, they would acquire from the air a part at least of the nitrogen which is so valuable an element. This crop would, too, hold fast to the soil and prevent mechanical losses due to washing, so liable to occur in winter.

In many cases it is desirable to pasture because the large fall growth of the clover, if not removed, will increase the danger of smothering in winter. Should, however, the conditions not be favorable and the plants die before spring, the nitrogen in the fall crop, either absorbed from the soil or accumulated from the air, will amount to an equivalent of five to six tons of yard manure per acre, in addition to the improvement of soil due to the considerable organic matter in the crop. The crop may be turned under at any time when it is convenient for the oats which follow the corn, thus not interfering in any way with the rotation, though naturally the amount of food gathered for the oat crop will be small, owing to its early seeding. The gain here is chiefly due to the prevention of losses. When there is injury to the clover crop, due to very dry weather following seeding, or because of unfavorable conditions which make careful seeding impossible, the advantages gained by the use of this crop may be in part attained if with the clover is mixed seed of the turnip, or Dwarf Essex rape, a half pint of seed per acre of each of these plants, used with the clover seed, using the same amount of clover, will be sufficient to give a considerable number of plants per acre, and will not interfere with the growth of the clover, should the conditions be favorable for its development, and if not, then the covering of the soil by the plants of the turnip and rape will be sufficient to absorb and retain food that is liable to be wasted, besides there will be an accumulation of vegetable matter useful in the improvement of the soil and in the feeding of other crops. The soil will be covered, even though the plants die, with a mulch of vegetable matter that will prevent the washing and mechanical losses due to heavy storms. Where neither crimson clover, turnips or rape are regarded as available plants for the purpose, then rye or wheat may be seeded at the last cultivation of the corn, at the rate of one and one-half bushels per acre.

By this method of practice a growing plant of the "nitrogen consuming" class is used, which will in its growth hold fast to the available food liable to be lost, besides filling the ground with roots and preventing mechanical losses. This crop may be turned under early in the spring without interfering with the rotation, though naturally the only gain will be the saving in the soil of food that would be liable to be lost. The chief advantage of the nitrogen consuming crops when used for this purpose, has been, as will be observed from the previous discussion, is to hold fast to food that may be lost, as the growth of the crops will not in any large degree increase the constituents in or improve the properties of the soil, as the oats seeded early in the spring will prevent the crops from making any considerable accumulation of food from soil and air.

The next point to be considered is the protection of the soil, as well as its possible improvement after the oats are harvested, and before the succeeding crop is planted. It is preferable in this case, of course, to use a plant which will accumulate nitrogen from the air, renovating rather than exhaustive in its character, as the crop which follows, namely, wheat or rye, is a nitrogen consumer, whose entire and only source of nitrogenous food is the soil. A nitrogen consuming crop, as millet, for example, or even buckwheat, would use tóo completely the available food in the surface soil, converting it into organic forms and hence make the conditions of soil less favorable for the wheat in respect to available plant food, than if the crop had not been grown. Furthermore, a crop must be grown which develops rapidly, in order that a large accumulation of nitrogen and organic matter may be made in a short time, say six weeks or two months. For this purpose, therefore, no better plants can be suggested than the cow pea or soy bean.

It is not necessary in the seeding of these plants that the land should be plowed after the oats are removed, if the surface two or three inches of soil can be made fine with a Cutaway harrow, in fact, this is a better practice than to plow, as the losses of moisture due to the preparation will be much less and the possible effect of dry weather in part avoided. Hence, immediately after the oats are removed prepare the land and seed cow peas or soy beans at the rate of one and one-half bushels per acre; they may be broadcasted, harrowed in, or put in with the grain drill, and preferably dressed with 250 pounds per acre of a mixture of four parts of acid phosphate and one part of muriate of potash. This added fertility is to ensure an abundance of available mineral food, so necessary in order that the plant may be induced to appropriate nitrogen from the air. This, of course, will remain in the soil for the use of the wheat or rye, which follows. At this season, if there is sufficient moisture, the plants germinate quickly and grow rapidly and will in six weeks make a considerable crop.

The advantages of growing a crop of this character are, first, that the soil is very soon covered with a plant of a large leafy growth, thus protecting the soil from the direct rays of the sun, and preventing the destruction of organic life, due to hot and dry conditions, and in the second place, there is an accumulation of nitrogenous vegetable matter, which when plowed into the soil is useful for the succeeding "nitrogen consuming" crop; and third, there is no interference with the growth of the regular crops of the rotation. That is, even though the period of growth is not long enough to cause the complete development or full maturity of the plant, it can be turned under when convenient, with the satisfaction of knowing that even though a small crop has been secured the soil is better, both physically and chemically, for the growth of the following wheat crop than it would have been if the land had been left bare.

Failures Should not Discourage.

As in the case with a number of other crops, failures sometimes occur, particularly in the catch of crimson clover. This is not always due to the season, though frequently such is the case. It is my judgment that the failures are more frequently due to the lack of proper preparation of the soil and seeding. In many cases the plants are starved in the beginning because the rapid growing of the corn absorbs the food and moisture, hence, if the seeds are placed deeply the danger from this source is not so great. It often happens too, that the preparation of the land for corn and its cultivation have not been of the best; the land is hard and cloddy and thus too little food is available for the clover. Sometimes, too, the soil may be slightly acid, which would make it an unfavorable medium for the growth of the soil organisms, whose presence have so important a bearing upon the growth of the crop; strict attention to those points which are important in the growing of any money crop is quite necessary in the successful growing of catch crops. It is recommended that where failures have occurred that the seed be covered more deeply and that in the preparation for corn the land be well tilled and preferably limed, say at the rate of 25 bushels per acre, either the year before planting on the sod, or early in the spring after plowing, and well harrowed in, and on land not in a good state of cultivation, this practice should be followed by a broadcast dressing of acid phosphate at the rate of 250 pounds per acre. The lime will neutralize the acidity of the soil, the acid phosphate will ensure an abundance of available phosphoric acid for the plant, which requires considerable in its early growth and a deeper seeding will cause a better hold of root and enable the plant to withstand a lack of moisture, which is one chief difficulty encountered in the seeding with corn. In the growing of the cow pea, after oats, it is very desirable if the best results are to be obtained, that the plant have at its disposal a sufficient amount of available phosphoric acid; the addition of this for the benefit of the catch crop will not be lost, but be recovered again by the crop of wheat, and by making conditions favorable for the growth of the cow pea the plant is in a position to fully exert its function in the way of appropriating nitrogen.

Danger of Injury to Soil by Green Manuring.

A word of caution should be given concerning the turning under of green crops as manure. If the conditions of season are not favorable, i. e., too warm and moist, the land may be injured rather than benefited by the turning under of so large a mass of material. It may ferment or change too rapidly, the rapid decay developing an acid, which may be so great as to cause injury to the soil. If, on the other hand, it is too dry, the crop does not decay for some time; a mass of vegetable matter lies between the surface and subsoil, which prevents capillary attraction, and results in a greater drying of the surface soil than would be the case if no crop had been grown. In either of these cases the possible disadvantages should be recognized. Hence, where a crop of some size is turned under in hot weather it is desirable to add lime, which will neutralize the acid and assist in the decomposition of the vegetable matter. If the crop is too heavy, a part at least should be removed and great care taken to thoroughly "firm" the soil after it has been turned down. It is also well to remember that a too frequent turning under of heavy green manure crops will rapidly increase the soil's content of nitrogen, and unless large applications of minerals are made, the soil may become so rich in this element as to cause too great a leaf growth of the cereal plants. When this stage is reached the practice should be changed, the crop of cow peas should be used as before, but preferably used as forage or made into hay, and only the roots and stubble turned under for the wheat. The chances are that in most cases this would be the better practice from the standpoint of soil improvement—it certainly would be a more economical method of practice where the forage can be used to advantage.

The Application of the Principles in Other Rotations.

The principles that have been pointed out in this discussion relative to the addition of crops that may be used in this rotation, in order to improve the soil, hold true for other crop rotations, when the land is left bare for any considerable period, and also in reference to the improvement that may come from the introduction into the soil of considerable vegetable matter containing nitrogen, which has not been drawn from soil sources. Still, suggestions as to changes in practice which may result in increasing the area and yield of more useful crops may be of service. For example, in growing corn, it has been demonstrated beyond a doubt that this crop may be grown on good land many years in succession on the same land, while at the same time maintaining, if not increasing, the yield of crop, provided a crop of crimson clover is grown and plowed down. That is, because of the holding fast of the soluble constituents liable to be lost in fall and spring, and because of the accumulation of vegetable matter and of nitrogen, by virtue of the clover crop, the corn is supplied with a greater abundance of mineral elements and of nitrogen each year, and the soil is not exhausted of its vegetable matter.

Soils naturally rich in minerals, with the improved physical character, due to the introduction of the catch crops, will provide the corn plant with a full supply from year to year without direct or heavy applications of fertilizer supplies. This practice would be very desirable on dairy farms, where a large yield of corn for the silo is an important factor. It may be modified still further and made more profitable by using a part of the clover instead of turning it under, as in the middle States the clover will be ready to harvest from the middle of May until the first of June, depending upon the season, or in time to permit the proper maturity of corn planted after that date. Hence, when the clover is seeded for the purpose of using in part on pasture, forage or hay, the land should be cultivated as nearly level as possible, and the corn stubble broken down or rolled off in winter. The crop may be pastured earlier than any other clover, and it may be cut for green forage or hay by the 20th of May, or in time for the planting of another crop. The removal of the clover, of course, results in reducing the amount of vegetable nitrogenous matter introduced into the soil, and for best results the soils should be matured in addition to the application of the mineral constituents, though in many cases the harvesting will be imperfect and a very sufficient amount left to considerably increase the supplies for the corn crop.

Where the rotation consists of corn, late potatoes, wheat and clover, the crimson clover seeded in the corn may be allowed to partially mature, thus making a very considerable addition of food to the soil for the potato plant. This is a very excellent rotation, resulting in very materially improving the soil, particularly when the potato crop is a profitable one, as it enables the use of two clover crops, both contributing to soil improvement, besides, the potato is not an exhaustive crop. In this rotation the cow pea could not be readily introduced, as the wheat should be sown almost immediately after the potatoes are removed.

Modifications of various rotations may be adopted and the usefulness of the proper catch crop very easily demonstrated. The main points to be observed is to keep the soil covered between crops with a leguminous crop, if possible, but with some crop, in order to be sure of this; in the case of the corn a mixture of the crimson clover and other seeds, as turnips or rape, may be made, so that the catch is there in any case, though if only the fall growth is obtained, the advantages of a fall covering are many, namely, a very handsome return is obtained on the investment for seed and the labor involved.

Improvement of Poor or Rundown Soils.

Where soils are poor, and the primary object is to build up or make "condition" rapidly, rather than to secure money crops, the leguminous crops should be more generally and continuously used. The land, for example, which has been run down, lacks both chemical and physical character. The crops grown have been exhaustive, the land badly cultivated and condition such as to make it unprofitable to use direct fertilization for the purpose. The questions are what crops shall I use and how shall I use them to the best advantage in order that money crops may be grown the second year?

If it is necessary to begin in the spring, the first crop used may be the Canada field pea. This should be seeded deeply, as early as it is possible to prepare the land, at the rate of about two bushels per acre, and the land should preferably receive a dressing of say 500 pounds of a mixture of 400 pounds of acid phosphate and 100 pounds of muriate of potash per acre. This crop may be plowed down, in our middle States by the first of July, and may be followed immediately by a crop of cow peas, seeded as already recommended and without further fertilization, and this crop plowed down by the middle of September, the land preferably limed at the rate of 25 bushels per acre, obeying in both cases the precaution to thoroughly "firm" the soil by rolling. This may be followed by a seeding of rye and sand vetch, one bushel of rye and one bushel of vetch, preferably fertilized with a dressing of 200 pounds of acid phosphate and 200 pounds of ground tankage per acre, preferably to secure a good catch and growth of rye. This combined crop may be turned under in spring for corn, without the further addition of fertility elements, and a rotation, the adoption of which is suitable to soil and conditions, provided it permits of the introduction of leguminous catch crops.

Here we have in one season, or previous to the planting of the corn, three crops of a leguminous character, which should very materially change and improve the character of the soil, making a heavy soil more open and porous and absorptive, and a light soil more compact and retentive, besides furnishing a very considerable percentage of nitrogen available for the succeeding crops. Naturally, if the soil is poor it will be necessary to continue with as many leguminous crops in the rotation as it is possible to introduce. For a year or two at least, keeping the number of money crops in the rotation as low as possible.

The object of this work is to point out, so far as it is known to the writer, the principles involved in the natural improvement of soils; with these understood the individual farmer will be better capable of selecting his crops useful for the purpose than any one else, as he is familiar with his climatic and seasonal conditions, his own soil and its adaptation for the various crops, both "catch" and "money." He should remember, too, that the knowledge of these things is yet very incomplete and that he must not rest satisfied with the improvement that may be obtained by its use, but to take advantage of such further additions as may be made from time to time, as the resut of scientific investigations.

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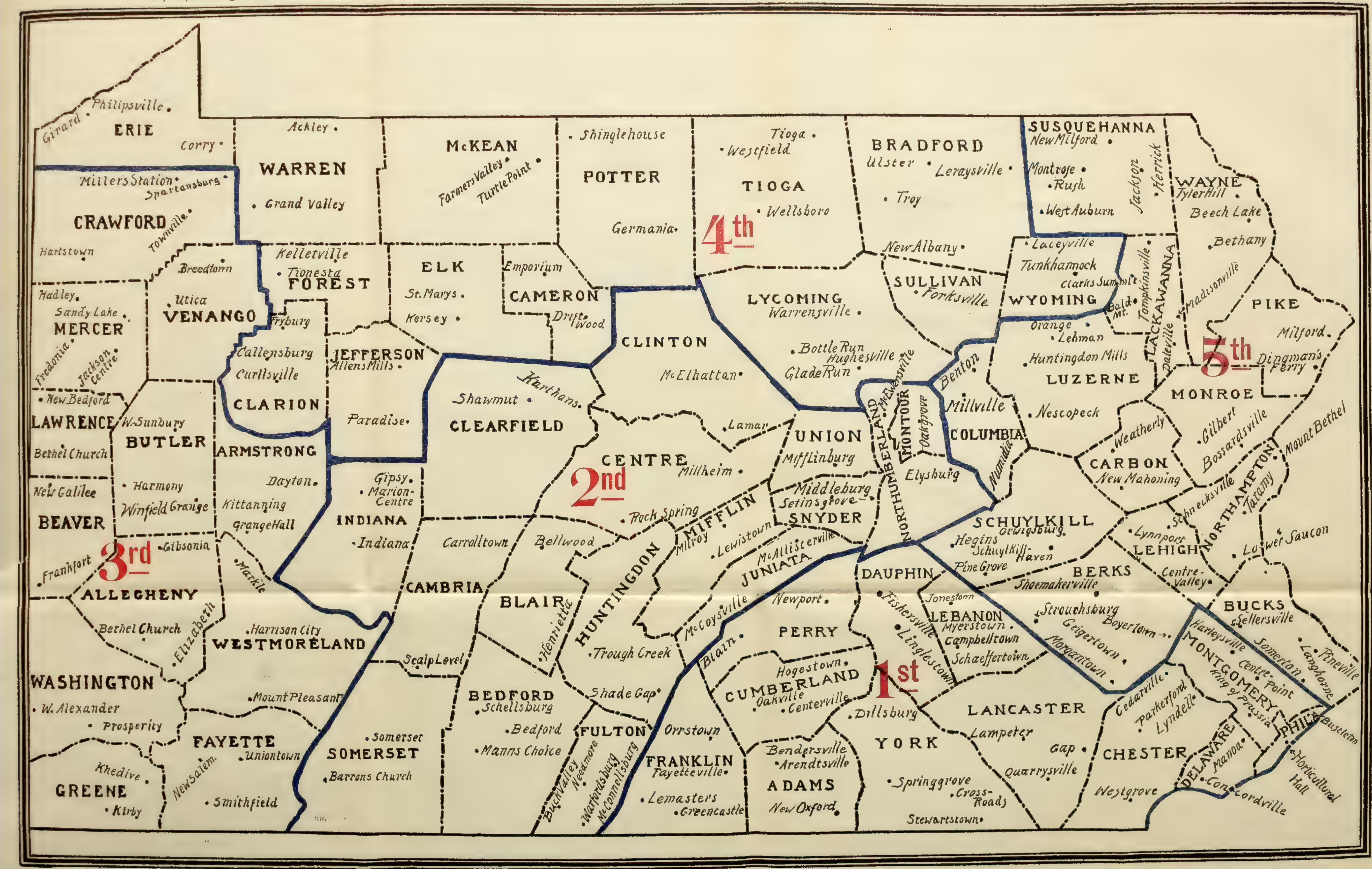
PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

DIVISION OF FARMERS' INSTITUTES.

Map representing the State by Counties, together with the five Institute Sections into which it is divided; and presenting the names and location of places where Institutes will be held during the season of 1902-1903.



THE LARGE NUMERALS INDICATE THE SECTIONS.

COMMONWEALTH OF PENNSYLVANIA.

BULLETIN No. 103.

FARMERS' INSTITUTES

IN

PENNSYLVANIA.

TO BE HELD UNDER THE AUSPICES OF

The Department of Agriculture of the State of Pennsylvania,

DURING THE SEASON OF 1902-1903.

ACT OF THE LEGISLATURE OF MARCH 13, 1895.

"Section 5. That it shall be the duty of the Superintendent of Institutes to arrange them in such manner as to time and places of holding the same, as to secure the greatest economy and efficiency of service, and to this end he shall, in each county where such institutes are to be held, confer and advise with the local member of the State Board of Agriculture, together with representatives duly appointed by each county agricultural, horticultural and other like organizations with reference to the appointment of speakers and other local arrangements."

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LETTER OF TRANSMITTAL.

DEPARTMENT OF AGRICULTURE.

Harrisburg, Pa., September 16, 1902.

Hon. John Hamilton, Secretary of Agriculture:

Dear Sir: In accordance with the provisions of the Act creating the Department of Agriculture, I have the honor to present herewith the schedule of Farmers' Institutes of Pennsylvania for the season of 1902-1903; also, a complete list of lecturers, with their subjects and assignments.

Very respectfully,
A. L. MARTIN,
Deputy Secretary and Director of Institutes.

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

Division of Institutes.

Harrisburg, Pa., September 16, 1902.

To the County Chairman and Boards of Institute Managers in the
Several Counties of Pennsylvania:

Gentlemen: In presenting this annual Bulletin, we desire to express approval of the work accomplished by most of our County Institute Managers and the committees organized by them to whom much credit is due for the high degree of success attending the last season's Institutes. We respectfully invite your careful attention to "Suggestions and Directions" on the following pages, which are prepared with reference to the requirements and demands of persons filling the position of County Chairman of Institutes.

SUGGESTIONS TO INSTITUTE MANAGERS.

Prepare programme at least thirty days before date of Institute.

Arrangements should be made with persons in your locality who are to participate in Institute at least eight weeks previous to meeting.

Have a Question Box, and place it in charge of some competent person who will carefully conduct the same; retain said questions and forward them to the Deputy Secretary of Agriculture.

Exclude from Institutes all sectarian and partisan topics.

Print on programme the name of Chairman and members of Committees.

Thoroughly advertise the Institute by distributing programmes, invitation by postal cards, posters, and make use of your local newspaper.

Select a competent Secretary to take notes and report proceedings of meeting to local papers.

Invite representatives of newspapers to a place at Recording Secretary's table, and solicit their aid and assistance in reporting proceedings of meeting.

For a two-days' Institute, provide for five sessions, each session devoted to a certain topic (see sample programme in Bulletin) and have no local speaker crowded off programme for want of time, unless unavoidable.

Locate Institutes where a suitable hall or church can be procured and the greatest number accommodated, as these meetings are for the benefit of farmers and their families.

Extend a personal invitation to your County Superintendent of Public Schools to be present and take part, especially at the educational session, without which no Institute is complete. Invite all farm organizations, school teachers and children, especially the ladies to attend and take part in the exercises.

Three State speakers will be in attendance, and a list of topics which they are prepared to discuss can be found in another part of this Bulletin. From this list the Committee on Programme should select such topics as would most interest the farmers in their section, and place same opposite the lecturer's name on programme.

The County Chairman should, as soon as arrangements are completed for holding Institute, enclose to all lecturers expected to be present, a copy of programme, with letter designating what railroad station to stop at, and the name of the hotel secured for their accommodation. In case Institute is held at a distance from railroad, speakers must be met by conveyance and taken to Institute. The expense of getting from and to such stations is from funds placed in hands of County Chairman.

Remember the Institute is for the whole county and not merely for the town or locality where held. Begin advertising and do not fail to let the public know of your meeting.

The State is divided into five sections. Beginning December 1st, five Institutes will be in session at the same time. Three State speakers will be present at all Institutes, one of whom will be a special representative of the Department and have charge of the section, and may be regarded as an assistant to the presiding officer in the performance of his duties.

It is important that the Chairman of County Board of Institute Managers make a complete report of his Institutes, and mail same to the Director of Institutes as soon as possible after the close of the Institutes. Blanks for this purpose will be forwarded him. All essays of merit, read before Institutes, should be collected by the County Chairman, and forwarded to the Director of Institutes. A number of these essays are published in the annual report, and we regret that space forbids that all can not be published. In selecting essays for publication, we find many treating upon the same topic, all of which are meritorious, yet space would forbid the publication of more than one essay upon a given topic. These papers are placed upon file and kept for future reference.

DIRECTIONS FOR CONSTITUTING LOCAL COMMITTEES ON INSTITUTE WORK IN THE SEVERAL COUNTIES OF PENNSYLVANIA.

The act of March 13, 1895 (section 5), makes the following provisions: "That it shall be the duty of the Superintendent of Institutes to arrange them in such manner as to time and places of holding the same, as to secure the greatest economy and efficiency of service, and to this end he shall, in each county where such institutes are to be held, confer and advise with the local member of the State Board of Agriculture, together with the representatives duly appointed by each county agricultural, horticultural or other like organizations, with reference to the appointment of speakers and other local arrangements."

In order to carry this provision of the law into effect, the Director of Institutes directs that these representatives, one from each county organization as stated, duly chosen and properly accredited, together with the local member of the State Board of Agriculture, shall constitute a board of County Institute Managers, of which the local member of the State Board of Agriculture shall be the Chairman. The organizations entitled to representation, are, county agricultural societies, county horticultural societies, pomona granges and county alliances.

The duty of this board shall be to confer and advise with each other and the Director of Institutes, with reference to the appointment of speakers and other local arrangements for holding institutes.

It shall be the duty of each county organization named, to notify the Director of Institutes of the appointment of its representatives, and at the same time give a similar notice to the local member of the State Board of Agriculture, if there is one in that county.

The local member of the State Board of Agriculture, together with these representatives of the county organizations, shall meet for organization on the second Tuesday in June in each year, at one o'clock P. M., in the county town, at the office of the county commissioners. At this meeting the places for holding institutes for the ensuing season shall be selected, the same to be subject to the approval of the Director of Institutes. An institute committee will also be apponted at this time, for each locality in which institutes are to be held.

The local member of the State Board, and each duly accredited representative of the county organizations in attendance upon this meeting shall, upon the certificate of the chairman of the board of managers, be paid his expenses, not to exceed two dollars.

In these meetings every member shall have equal voice, and the action of the majority shall decide. Notice of the action of the board shall be sent by the chairman to the Director of Institutes, within ten days after the meeting.

In counties where the State Board of Agriculture has no member, or when he may for any reason decline to serve as member and chairman of the committee, the representatives of the county organizations mentioned, shall elect a chairman and notify the Director of Institutes of the fact. Or, if after the meeing for organization the chairman does not call a second meeting of the committee at least sixty days prior to the date fixed for holding the first institute, then the other members shall meet and proceed to arrange for the institute, first notifying the Director of Institutes of their action.

In case no representative from any county organization of that county shall appear in the meeting on the second Tuesday of June as stated, then the County Chairman of Institutes shall immediately report the fact to the Director of Institutes and proceed to arrange for the holding of institutes that year, without further consultation with the local organizations.

All moneys allotted to any county, for use in institute work will be paid to the chairman of the local committee, to be accounted for by him in an itemized statement, audited and signed by auditors appointed by the committee, and then forwarded to this Department, not later than the first day of May in each year.

APPORTIONMENT FOR THE SEASON OF 1902-1903.

In order that the boards of institute managers may have full information in regard to the plans of the Department, as to the institute work for the coming season, the following distribution of time for holding institutes is presented.

The apportionment shows the number of days that the Department will furnish three lecturers to each county for institute work during the season of 1902-1903. It is made on the basis of two days of institute, to every county having not over 1,000 farms; three days to each county having more than 1,000 and not over 1,500; afterwards, one day for each 1,500 farms or fraction thereof additional. This insures Department aid to each county, in proportion to its agricultural interests.

The State has been divided into five sections. A separate set of lecturers will be assigned to each section, and in a given county, the same Department workers will continue until all the institutes in that county have been held.

The amount of money to be distributed to the various managers for local expenses, will be according to the number of days of institutes held. In order to make the amount ample for the coming season, the sum has been fixed at $12.50 per day of institute. This provides $25.00 for each two days of institute, to be used for local expenses, such as printing programmes, rent of halls, necessary expenses of local managers, etc.

Past experience in most of the counties has shown that the two days institute is much more economical and efficient than the one day meeting. In the one day meeting the time is usually given to the visiting lecturers to the exclusion of local aid, on the ground that the people wish to hear the strangers, and as there is not time to hear all, the visitors are given the preference. This is a serious mistake. The main object of the institute is the development of the local people, and whatever interferes with this ought to be corrected. A two day institute gives ample time for all to be heard, and provides also for the deliberate and full discussion of matters of interest that may arise. The morning session of the first day is almost always a failure, and ought to be dropped, and the institute begin at 1 P. M., and continue for five sessions. This gives time for the visiting lecturers to reach the ground, and begin the work with the advantage of a full house.

APPORTIONMENT FOR 1902-1903.

Section 1.		Section 2.		Section 3.		Section 4.		Section 5.	
COUNTY.	Days.	COUNTY.	Days.	COUNTY.	Days.	COUNTY.	Days.	COUNTY.	Days.
Adams,	5	Bedford,	5	Allegheny,	6	Bradford,	8	Berks,	7
Chester,	7	Blair,	4	Armstrong,	5	Clarion,	6	Bucks,	7
Cumberland,	4	Cambria,	4	Butler,	6	Cameron,	3	Carbon,	2
Dauphin,	4	Centre,	4	Beaver,	4	Elk,	3	Columbia,	5
Delaware,	4	Clearfield,	4	Crawford,	8	Erie,	6	Lehigh,	5
Franklin,	5	Clinton,	3	Fayette,	5	Forest,	3	Luzerne,	4
Lancaster,	9	Fulton,	3	Greene,	4	Jefferson,	4	Lackawanna,	4
Lebanon,	4	Huntingdon,	4	Lawrence,	4	Lycoming,	5	Monroe,	4
Montgomery,	6	Indiana,	6	Mercer,	6	McKean,	4	Northampton,	5
Perry,	4	Juniata,	4	Venango,	4	Potter,	4	Pike,	2
Philadelphia,	3	Mifflin,	3	Washington,	5	Sullivan,	2	Schuylkill,	4
York,	8	Montour,	2	Westmoreland,	5	Tioga,	6	Susquehanna,	6
		Northumberland,	4			Warren,	4	Wayne,	6
		Snyder,	4			Wyoming,	4		
		Somerset,	5						
		Union,	3						
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COMPLETE LIST

OF

Pennsylvania Farmers' Institutes.

SEASON OF 1902-1903.

Giving the Counties in Alphabetical Order, and the Name and Address of the Chairman of Each County.

County.	Place.	Date.	Chairman of Institute Committee.
Adams,	New Oxford,	Dec. 15-16,	A. I. Weidner, Arendtsville.
	Arendtsville,	Dec. 17-18,	
	Bendersville,	Dec. 19,	
Allegheny,	Bethel Church,	Dec. 29-30,	J. S. Burns, Clinton.
	Elizabeth,	Dec. 31, Jan. 1,	
	Gibsonia,	Jan. 2-3,	
Armstrong,	Dayton,	Feb. 25-26,	S. S. Blyholder, Leechburg.
	Grange Hall,	Feb. 27-28,	
	Kittanning,	March 2,	
Beaver,	New Galilee,	Jan. 16-17,	A. L. McKibben, New Sheffield.
	Frankfort,	Jan. 27-28,	
Bedford,	Bedford,	Dec. 5-6,	W. Clay Lutz, Bedford.
	Schellsburg,	Dec. 8-9,	
	Manns Choice,	Dec. 10,	
Berks,	Boyertown,	Jan. 16,	H. G. McGowan, Geiger's Mills.
	Geigertown,	Jan. 17,	
	Strouchsburg,	Jan. 30-31,	
	Shoemakersville,	Feb. 2-3,	
	Morgantown,	Feb. 4,	
Blair,	Bellwood,	Jan. 26-27,	H. L. Harvey, Kipple.
	Henrietta,	Jan. 28-29,	
Bradford,	Leraysville,	Dec. 5-6,	Louis Piollet, Wysox.
	Ulster,	Dec. 8-9,	
	Troy,	Dec. 10-11,	
	New Albany,	Dec. 12-13,	
Bucks,	Sellersville,	Jan. 12-13,	Watson T. Davis, Ivyland.
	Pineville,	Jan. 14-15,	
	Somerton,	Jan. 26-27,	
	Langhorne,	Jan. 28-29,	
Butler,	Winfield Grange,	Jan. 5-6,	W. H. H. Riddle, Butler.
	West Sunbury,	Jan. 7-8,	
	Harmony,	Jan. 9-10,	

DIVISION OF INSTITUTES—Continued.

County.	Place.	Date.	Chairman of Institute Committee.
Cambria,	Scalp Level,	Dec. 18-19,	H. J. Krumenacker, Nicktown.
	Carrolltown,	Dec. 29-30,	
Cameron,	Emporium,	Jan. 12-13,	W. H. Howard, Emporium.
	Driftwood,	Jan. 14,	
Carbon,	New Mahoning,	Feb. 11,	J. A. Werner, Weatherly.
	Weatherly,	Feb. 12,	
Centre,	Millheim,	Jan. 15-16,	John A .Woodward, Howard.
	Rock Spring,	Jan. 30-31,	
Chester,	Lyndell,	Jan. 16-17,	Dr. M. E. Conard, Westgrove.
	Parkerford,	Feb. 14,	
	Cedarville,	Feb. 20-21,	
	Westgrove,	Feb. 27-28,	
Clarion,	Fryburg,	Feb. 18-19,	S. X. McClellan, Knox.
	Callensburg,	Feb. 20-21,	
	Curllsville,	Feb. 23-24,	
Clearfield,	Shawmut,	Jan. 7-8,	J. W. Nelson, Shawmut.
	Karthaus,	Jan. 9-10,	
Clinton,	McElhattan,	Jan. 12-13,	Joel A. Herr, Cedar Springs.
	Lamar,	Jan. 14,	
Columbia,	Numidia,	Feb. 23-24,	H. V. White, Bloomsburg.
	Millville,	Feb. 25-26,	
	Benton,	Feb. 27.	
Crawford,	Hartstown,	Feb. 6-7,	M. W. Oliver, Conneautville.
	Millers Station,	Feb. 9-10,	
	Spartansburg,	Feb. 11-12,	
	Townville,	Feb. 13-14,	
Cumberland,	Oakville,	Dec. 9-10,	R. H. Thomas, Mechanicsburg. Rev. T. J. Ferguson, Hogestown.
	Hogestown,	Dec. 11-12,	
	Centerville,	Dec. 13,	
Dauphin,	Linglestown,	Dec. 29-30,	S. F. Barber, Harrisburg.
	Fisherville,	Dec. 31, Jan. 1,	
Delaware,	Manoa,	Jan. 14-15,	J. Milton Lutz, Llanerch.
	Concordville,	Feb. 25-26,	
Elk,	Saint Marys,	Jan. 15-16,	Joseph Kaiser, St. Marys.
	Kersey,	Jan. 17,	
Erie,	Corry,	Feb. 4-5,	Archie Billings, Edinboro.
	Girard,	Feb. 6-7,	
	Philipsville,	Feb. 9-10,	
Fayette,	Uniontown,	Dec. 6,	J. M. Hantz, Merrittstown.
	New Salem,	Dec. 8-9,	
	Smithfield,	Dec. 10-11,	
Forest,	Tionesta,	Feb. 11-12,	Chas. A. Randall, Tionesta.
	Kellettsville,	Feb. 13,	
Franklin,	Orrstown,	Dec. 1-2,	C. B. Hege, Marion.
	Fayetteville,	Dec. 3-4,	
	Lemasters,	Dec. 5-6,	
	Greencastle,	Dec. 8,	

DIVISION OF INSTITUTES—Continued.

County.	Place.	Date.	Chairman of Institute Committee.
Fulton,	McConnellsburg,	Dec. 1,	R. M. Randall, McConnellsburg.
	Needmore,	Dec. 2,	
	Buck Valley,	Dec. 3,	
	Warfordsburg,	Dec. 4,	
Greene,	Kirby,	Dec. 12-13,	J. Ewing Bailey, Carmichaels.
	Khedive,	Dec. 15-16,	
Huntingdon,	Shade Gap,	Feb. 2-3,	G. G. Hutchison, Warrior's Mark
	Trough Creek,	Feb. 4-5,	
Indiana,	Indiana,	Dec. 31, Jan. 1,	S. M. McHenry, Indiana.
	Marion Centre,	Jan. 2-3,	
	Gypsy,	Jan. 5-6,	
Jefferson,	Allens Mills,	Feb. 25-26,	Chas. G. McClain, Ringgold.
	Paradise,	Feb. 27-28,	
Juniata,	McAlisterville,	Feb. 23-24,	Matthew Rodgers, Mexico.
	McCoysville,	Feb. 25-26,	
Lackawanna,	Tompkinsville,	Dec. 8,	H. W. Northup, Glenburn.
	Clarks Summit,	Dec. 9,	
	Bald Mount,	Dec. 10,	
	Daleville,	Dec. 11,	
	Madisonville,	Dec. 12,	
Lancaster,	Lampeter,	Jan. 7-8,	W. H. Brosius, Fernglen.
	Quarryville,	Jan. 9-10,	
	Gap,	Jan. 12-13,	
Summer Institutes,	Heisey's Park,	Sept. 10,	
	Rutland Park,	Sept. 11,	
	Black Barren Springs,	Sept. 12-13,	
Lawrence,	New Bedford,	Jan. 12-13,	Samuel McCreary, Neshannock Falls.
	Bethel Church,	Jan. 14-15,	
Lebanon,	Campbelltown,	Feb. 4,	H. C. Snavely, Lebanon.
	Jonestown,	Feb. 5,	
	Myerstown,	Feb. 6,	
	Schaefferstown,	Feb. 7.	
Lehigh,	Schnecksville,	Feb. 5-6,	J. L. Schreiber, Hosensack.
	Lynnport,	Feb. 7,	
	Centre Valley,	Feb. 9-10,	
Luzerne,	Nescopeck,	Feb. 28,	J. E. Hildebrant, Lehman.
	Huntingdon Mills,	March 2,	
	Lehman,	March 3,	
	Orange,	March 4,	
Lycoming,	Hughesville,	Dec. 17-18,	A. J. Kahler, Hughesville.
	Bottle Run,	Dec. 19,	
	Warrensville,	Dec. 20,	
	Glade Run,	Dec. 29,	
McKean,	Farmer's Valley,	Jan. 26-27,	Chas. N. Barrett, Port Allegany.
	Turtle Point,	Jan. 28-29,	
Mercer,	Jackson Centre,	Jan. 29,	S. A. Williams, Volant, 4 R. D.
	Sandy Lake,	Jan. 30-31,	
	Hadley,	Feb. 2-3,	
	Fredonia,	Feb. 4-5,	

DIVISION OF INSTITUTES—Continued.

County.	Place.	Date.	Chairman of Institute Committee.
Mifflin,	Lewistown,	Feb. 6-7,	D. E. Notestine, Lewistown.
	Milroy,	Feb. 9,	
Monroe,	Bossardsville,	Dec. 31, Jan. 1,	Randall Bisbing, E. Stroudsburg.
	Gilbert,	Jan. 2-3,	
Montgomery,	Harleysville,	Feb. 9-10,	Jason Sexton, North Wales.
	Centre Point,	Feb. 18-19,	
	King of Prussia,	Feb. 23-24,	
Montour,	Oakgrove,	Feb. 27-28,	J. K. Murray, Pottsgrove.
Northampton,	Mount Bethel,	Jan. 5-6,	Wm. F. Beck, Nazareth.
	Tatamy,	Jan. 7-8,	
	Lower Saucon,	Jan. 9-10,	
Northumberland,	McEwensville,	March 2-3,	J. A. Eshbach, Milton.
	Elysburg,	March 4-5,	
Perry,	Newport,	Jan. 2-3,	A. T. Holman, Nekoda.
	Blain,	Jan. 5-6,	
Philadelphia,	Horticultural Hall,	Feb. 11,	Edwin Lonsdale, Wyndmoor.
	Bustleton,	Feb. 12-13,	
Pike,	Milford,	Dec. 29,	J. K. Van Etten, Milford.
	Dingman's Ferry,	Dec. 30,	
Potter,	Germania,	Jan. 7-8,	Horace H. Hall, Ellisburg.
	Shingle House,	Jan. 9-10,	
Schuylkill,	Orwigsburg,	Feb. 13,	W. H. Stout, Pinegrove.
	Schuylkill Haven,	Feb. 14,	
	Hegins,	Feb. 19,	
	Pinegrove,	Feb. 20,	
Snyder,	Middleburg,	Feb. 10-11,	F. J. Schoch, Selinsgrove.
	Selinsgrove,	Feb. 12-13,	
Somerset,	Barron's Church,	Dec. 12-13,	N. B. Critchfield, Critchfield.
	Somerset,	Dec. 15-16-17,	
Sullivan,	Forksville,	Dec. 15-16,	John W. Rodgers, Forksville.
Susquehanna,	Herrick,	Dec. 1,	C. W. Brodhead, Montrose.
	Jackson,	Dec. 2,	
	New Milford,	Dec. 3,	
	Montrose,	Dec. 4,	
	Rush,	Dec. 5,	
	West Auburn,	Dec. 6,	
Tioga,	Wellsboro,	Dec. 30-31,	F. E. Field, Stonyfork.
	Tioga,	Jan. 1-2,	
	Westfield,	Jan. 5-6,	
Union,	Mifflinburg,	Feb. 19-20-21,	J. N. Glover, Vicksburg.
Venango,	Utica,	Feb. 20-21,	W. A. Crawford, Cooperstown.
	Breedstown,	Feb. 23-24,	

DIVISION OF INSTITUTES—Continued.

County.	Place.	Date.	Chairman of Institute Committee.
Warren,	Ackley,	Jan. 30-31,	R. J. Weld, Sugargrove.
	Grand Valley,	Feb. 2-3,	
Washington,	Prosperity,	Dec. 17-18,	D. M. Pry, Burgettstown.
	West Alexander,	Dec. 19-20,	
Wayne,	Beech Lake,	Dec. 15-16,	Warren E. Perham, Niagara.
	Tyler Hill,	Dec. 17-18,	
	Bethany,	Dec. 19-20,	
Westmoreland,	Markle,	Dec. 1-2,	M. N. Clark, Claridge.
	Harrison City,	Dec. 3,	
	Mount Pleasant,	Dec. 4-5,	
Wyoming,	Tunkhannock,	Dec. 1-2,	D. A. Knuppenburg, Lake Carey.
	Laceyville,	Dec. 3-4,	
York,	Cross Roads,	Jan. 26-27,	B. F. Kohler, Shrewsbury.
	Stewartstown,	Jan. 28-29,	
	Springgrove,	Jan. 30-31,	
	Dillsburg,	Feb. 2-3,	

PENNSYLVANIA FARMERS' INSTITUTES.

APPORTIONMENT FOR 1902-1903.

SCHEDULE OF DATES, PLACES AND ASSIGNMENTS OF LECTURERS BY SECTIONS.

Three lecturers are provided for every Institute.

Under the head of general list of subjects, the Institute Committee will find for their guidance, in preparing programmes, a complete list of topics which each lecturer will discuss.

A brief biography of lecturers is also herein given.

FIRST SECTION.

Prof. R. L. Watts will attend all meetings in this section.

Date.	Place.	County.	Additional Lecturers.
Dec. 1-2,	Orrstown,	Franklin,	L. W. Lighty and J. H. Peachy.
Dec. 3-4,	Fayetteville,	Franklin,	L. W. Lighty and J. H. Peachy.
Dec. 5-6,	Lemasters,	Franklin,	L. W. Lighty and J. H. Peachy.
Dec. 8,	Greencastle,	Franklin,	L. W. Lighty and J. H. Peachy.
Dec. 9-10,	Oakville,	Cumberland,	J. H. Ledy and L. W. Lighty.
Dec. 11-12,	Hogestown,	Cumberland,	J. H. Ledy and L. W. Lighty.
Dec. 13,	Centerville,	Cumberland,	J. H. Ledy and L. W. Lighty.
Dec. 15-16,	New Oxford,	Adams,	A. B. Lehman and Rev. J. D. Detrich.
Dec. 17-18,	Arendtsville,	Adams,	A. B. Lehman and Rev. J. D. Detrich.
Dec. 19,	Bendersville,	Adams,	A. B. Lehman and Rev. J. D. Detrich.
Dec. 29-30,	Linglestown,	Dauphin,	Dr. Harvey E. Bashore and W. H. Stout.

Date.	Place.	County.	Additional Lecturers.
Dec. 31, Jan. 1,	Fishersville,	Dauphin,	Dr. Harvey E. Bashore and W. H. Stout.
Jan. 2-3,	Newport,	Perry,	W. H. Stout and J. H. Peachy.
Jan. 5-6,	Blain,	Perry,	W. H. Stout and J. H. Peachy.
Jan. 7-8,	Lampeter,	Lancaster,	J. S. Burns and F. E. Field.
Jan. 9-10,	Quarryville,	Lancaster,	J. S. Burns, F. E. Field and Rev. J. D. Detrich.
Jan. 12-13,	Gap,	Lancaster,	J. S. Burns and F. E. Field.
Jan. 14-15,	Manoa,	Delaware,	J. S. Burns and F. E. Field.
Jan. 16-17,	Lyndell,	Chester,	J. S. Burns and F. E. Field.
Jan. 26-27,	Cross Roads,	York,	Dr. M. E. Conard, R. F. Schwarz and L. W. Lighty.
Jan. 28-29,	Stewartstown,	York,	R. F. Schwarz and L. W. Lighty.
Jan. 30-31,	Springgrove,	York,	R. F. Schwarz and L. W. Lighty.
Feb. 2-3,	Dillsburg,	York,	R. F. Schwarz, L. W. Lighty and Rev. J. D. Detrich.
Feb. 4,	Campbelltown,	Lebanon,	J. H. Ledy and W. A. Hutchison.
Feb. 5,	Jonestown,	Lebanon,	J. H. Ledy and W. A. Hutchison.
Feb. 6,	Myerstown,	Lebanon,	J. H. Ledy and W. A. Hutchison.
Feb. 7,	Schaefferstown,	Lebanon,	J. H. Ledy and W. A. Hutchison.
Feb. 9-10,	Harleysville,	Montgomery,	T. E. Orr and W. A. Hutchison.
Feb. 11,	Horticultural Hall,	Philadelphia,	T. E. Orr and W. A. Hutchison.
Feb. 12-13,	Bustleton,	Philadelphia,	T. E. Orr and W. A. Hutchison.
Feb. 14,	Parkerford,	Chester,	T. E. Orr and W. A. Hutchison.
Feb. 18-19,	Centre Point,	Montgomery,	John T. McDonald and Prof. J. M. Hantz.
Feb. 20-21,	Cedarville,	Chester,	John T. McDonald and Prof. J. M. Hantz.
Feb. 23-24,	King of Prussia,	Montgomery,	John T. McDonald and Prof. J. M. Hantz.
Feb. 25-26,	Concordville,	Delaware,	John T. McDonald and Prof. J. M. Hantz.
Feb. 27-28,	Westgrove,	Chester,	John T. McDonald and Prof. J. M. Hantz.

SECOND SECTION.

Robert S. Seeds will attend all meetings in this section. Prof. Geo. C. Butz will attend all meetings up to January 17; Dr. I. A. Thayer, January 26 to February 14; Prof. W. A. Buckhout, February 19 to March 5.

Date.	Place.	County.	Additional Lecturers.
Dec. 1,	McConnellsburg,	Fulton,	W. H. Stout.
Dec. 2,	Needmore,	Fulton,	W. H. Stout.
Dec. 3,	Buck Valley,	Fulton,	W. H. Stout.
Dec. 4,	Warfordsburg,	Fulton,	W. H. Stout.
Dec. 5-6,	Bedford,	Bedford,	W. H. Stout and W. H. H. Riddle.
Dec. 8-9,	Schellsburg,	Bedford,	W. H. Stout and W. H. H. Riddle.
Dec. 10,	Mann's Choice,	Bedford,	W. H. Stout and W. H. H. Riddle.
Dec. 12-13,	Barron's Church,	Somerset,	M. N. Clark and W. H. H. Riddle.
Dec. 15-16-17,	Somerset,	Somerset,	M. N. Clark and W. H. H. Riddle.
Dec. 18-19,	Scalp Level,	Cambria,	W. H. H. Riddle.
Dec. 29-30,	Carrolltown,	Cambria,	W. H. H. Riddle.
Dec. 31, Jan. 1,	Indiana,	Indiana,	J. S. Burns and John G. Foight.
Jan. 2-3,	Marion Centre,	Indiana,	J. S. Burns and John G. Foight.
Jan. 5-6,	Gypsy,	Indiana,	J. S. Burns and John G. Foight.
Jan. 7-8,	Shawmut,	Clearfield,	J. Y. Patton and M. S. Bond.
Jan. 9-10,	Karthaus,	Clearfield,	J. Y. Patton and M. S. Bond.
Jan. 12-13,	McElhattan,	Clinton,	J. Y. Patton and M. S. Bond.
Jan. 14,	Lamar,	Clinton,	J. Y. Patton and M. S. Bond.
Jan. 15-16,	Millheim,	Centre,	J. Y. Patton and M. S. Bond.
Jan. 26-27,	Bellwood,	Blair,	Joel A. Herr.
Jan. 28-29,	Henrietta,	Blair,	Joel A. Herr.
Jan. 30-31,	Rock Spring,	Centre,	Joel A. Herr.
Feb. 2-3,	Shade Gap,	Huntingdon,	Joel A. Herr.
Feb. 4-5,	Trough Creek,	Huntingdon,	Joel A. Herr.
Feb. 6-7,	Lewistown,	Mifflin,	C. W. Brodhead.
Feb. 9,	Milroy,	Mifflin,	C. W. Brodhead.
Feb. 10-11,	Middleburg,	Snyder,	C. W. Brodhead.

Feb.	12-13,	Selinsgrove,	Snyder,	C. W. Brodhead.
Feb.	19-20-21,	Mifflinburg,	Union,	S. W. H. Waltz.
Feb.	23-24,	McAlistersville,	Juniata,	Dr. M. E. Conard and S. W. H. Waltz
Feb.	25-26,	McCoysville,	Juniata,	S. W. H. Waltz.
Feb.	27-28,	Oakgrove,	Montour,	A. L. Brubaker.
March	2-3,	McEwensville,	Northumberland,	A. L. Brubaker.
March	4-5,	Elysburg,	Northumberland,	A. L. Brubaker.

THIRD SECTION.

R. J. Weld will attend all meetings in this section; Dr. Charles A. Browne, Jr., December 1 to January 17; Dr. William Frear, January 26 to March 2.

Date.		Place.	County.	Additional Lecturers.
Dec.	1-2,	Markle,	Westmoreland,	J. W. Cox.
Dec.	3,	Harrison City,	Westmoreland,	J. W. Cox.
Dec.	4-5,	Mt. Pleasant,	Westmoreland,	J. W. Cox.
Dec.	6,	Uniontown,	Fayette,	J. W. Cox and F. J. Wagner.
Dec.	8-9,	New Salem,	Fayette,	J. W. Cox and F. J. Wagner.
Dec.	10-11,	Smithfield,	Fayette,	J. W. Cox and F. J. Wagner.
Dec.	12-13,	Kirby,	Greene,	C. W. Brodhead.
Dec.	15-16,	Khedive,	Greene,	C. W. Brodhead.
Dec.	17-18,	Prosperity,	Washington,	C. W. Brodhead and T. E. Orr.
Dec.	19-20,	West Alexander,	Washington,	C. W. Brodhead and T. E. Orr.
Dec.	29-30,	Bethel Church,	Allegheny,	J. T. Campbell and T. E. Orr.
Dec. 31, Jan.	1,	Elizabeth,	Allegheny,	J. T. Campbell and T. E. Orr.
Jan.	2-3,	Gibsonia,	Allegheny,	J. T. Campbell and T. E. Orr.
Jan.	5-6,	Winfield Grange,	Butler,	L. W. Lighty.
Jan.	7-8,	West Sunbury,	Butler,	L. W. Lighty.
Jan.	9-10,	Harmony,	Butler,	L. W. Lighty.
Jan.	12-13,	New Bedford,	Lawrence,	L. W. Lighty.
Jan.	14-15,	Bethel Church,	Lawrence,	L. W. Lighty.
Jan.	16-17,	New Galilee,	Beaver,	L. W. Lighty.
Jan.	27-28,	Frankfort,	Beaver,	J. H. Peachy.
Jan.	29,	Jackson Centre,	Mercer,	J. H. Peachy.
Jan.	30-31,	Sandy Lake,	Mercer,	J. H. Peachy.
Feb.	2-3,	Hadley,	Mercer,	J. H. Peachy.
Feb.	4-5,	Fredonia,	Mercer,	J. H. Peachy.
Feb.	6-7,	Hartstown,	Crawford,	J. H. Peachy.
Feb.	9-10,	Miller's Station,	Crawford,	J. H. Peachy.
Feb.	11-12,	Spartansburg,	Crawford,	J. H. Peachy.
Feb.	13-14,	Townville,	Crawford,	J. H. Peachy.
Feb.	20-21,	Utica,	Venango,	J. S. Burns.
Feb.	23-24,	Breedstown,	Venango,	J. S. Burns.
Feb.	25-26,	Dayton,	Armstrong,	J. S. Burns.
Feb.	27-28,	Grange Hall,	Armstrong,	J. S. Burns.
March	2,	Kittanning,	Armstrong,	J. S. Burns.

FOURTH SECTION.

Prof. Wells W. Cooke and Hon. Thomas J. Philips will attend all meetings in this section.

Date.		Place.	County.	Additional Lecturers.
Dec.	1-2,	Tunkhannock,	Wyoming,	C. D. Northrop.
Dec.	3-4,	Laceyville,	Wyoming,	C. D. Northrop.
Dec.	5-6,	Leraysville,	Bradford,	C. D. Northrop.
Dec.	8-9,	Ulster,	Bradford,	C. D. Northrop.
Dec.	10-11,	Troy,	Bradford,	C. D. Northrop.
Dec.	12-13,	New Albany,	Bradford,	C. D. Northrop.
Dec.	15-16,	Forksville,	Sullivan,	George Campbell.
Dec.	17-18,	Hughesville,	Lycoming,	George Campbell.
Dec.	19,	Bottle Run,	Lycoming,	George Campbell.
Dec.	20,	Warrensville,	Lycoming,	George Campbell.
Dec.	29,	Glade Run,	Lycoming,	S. F. Barber.
Dec.	30-31,	Wellsboro,	Tioga,	S. F. Barber.
Jan.	1-2,	Tioga,	Tioga,	S. F. Barber.
Jan.	5-6,	Westfield,	Tioga,	S. F. Barber.
Jan.	7-8,	Germania,	Potter,	R. L. Beardslee.
Jan.	9-10,	Shingle House,	Potter,	R. L. Beardslee.
Jan.	12-13,	Emporium,	Cameron,	R. L. Beardslee.
Jan.	14,	Driftwood,	Cameron,	R. L. Beardslee.
Jan.	15-16,	St. Marys,	Elk,	R. L. Beardslee.
Jan.	17,	Kersey,	Elk,	R. L. Beardslee.
Jan.	26-27,	Farmer's Valley,	McKean,	George E. Hull.
Jan.	28-29,	Turtle Point,	McKean,	George E. Hull.
Jan.	30-31,	Ackley,	Warren,	George E. Hull.
Feb.	2-3,	Grand Valley,	Warren,	George E. Hull.
Feb.	4-5,	Corry,	Erie,	J. S. Burns.
Feb.	6-7,	Girard,	Erie,	J. S. Burns.
Feb.	9-10,	Philipsville,	Erie,	J. S. Burns.
Feb.	11-12,	Tionesta,	Forest,	J. S. Burns and D. C. Gillespie.
Feb.	13,	Kellettsville,	Forest,	J. S. Burns and D. C. Gillespie.
Feb.	18-19,	Fryburg,	Clarion,	A. J. Kahler and D. C. Gillespie.
Feb.	20-21,	Callensburg,	Clarion,	A. J. Kahler and D. C. Gillespie.
Feb.	23-24,	Curllsville,	Clarion,	A. J. Kahler and D. C. Gillespie.
Feb.	25-26,	Allen's Mills,	Jefferson,	A. J. Kahler.
Feb.	27-28,	Paradise,	Jefferson,	A. J. Kahler.

FIFTH SECTION.

Col. John A. Woodward will attend all meetings in this section; Dr. I. A. Thayer, December 1 to December 19; Prof. Franklin Menges, December 29 to March 4.

Date.	Place.	County.	Additional Lecturers.
Dec. 8,	Tompkinsville,	Lackawanna,	F. E. Field.
Dec. 9,	Clark's Summit,	Lackawanna,	F. E. Field.
Dec. 10,	Bald Mount,	Lackawanna,	F. E. Field.
Dec. 11,	Daleville,	Lackawanna,	F. E. Field.
Dec. 12,	Madisonville,	Lackawanna,	F. E. Field.
Dec. 1,	Herrick,	Susquehanna,	F. E. Field.
Dec. 2,	Jackson,	Susquehanna,	F. E. Field.
Dec. 3,	New Milford,	Susquehanna,	F. E. Field.
Dec. 4,	Montrose,	Susquehanna,	F. E. Field.
Dec. 5,	Rush,	Susquehanna,	F. E. Field.
Dec. 6,	West Auburn,	Susquehanna,	F. E. Field.
Dec. 15-16,	Beech Lake,	Wayne,	Hon. R. F. Schwarz.
Dec. 17-18,	Tyler Hill,	Wayne,	Hon. R. F. Schwarz.
Dec. 19-20,	Bethany,	Wayne,	Hon. R. F. Schwarz.
Dec. 30,	Milford,	Pike,	Z. T. Cure.
Dec. 30,	Dingman's Ferry,	Pike,	Z. T. Cure.
Dec. 31, Jan. 1,	Bossardsville,	Monroe,	Z. T. Cure.
Jan. 2-3,	Gilbert,	Monroe,	Z. T. Cure.
Jan. 5-6,	Mount Bethel,	Northampton,	Henry W. Northup.
Jan. 7-8,	Tatamy,	Northampton,	Henry W. Northup and J. H. Peachy.
Jan. 9-10,	Lower Saucon,	Northampton,	Henry W. Northup and J. H. Peachy.
Jan. 12-13,	Sellersville,	Bucks,	Henry W. Northup.
Jan. 14-15,	Pineville,	Bucks,	Henry W. Northup.
Jan. 16,	Boyertown,	Berks,	Henry W. Northup.
Jan. 17,	Geigertown,	Berks,	Henry W. Northup.
Jan. 26-27,	Somerton,	Bucks,	W. A. Hutchison.
Jan. 28-29,	Langhorne,	Bucks,	W. A. Hutchison.
Jan. 30-31,	Strouchsburg,	Berks,	Hon. Jason Sexton.
Feb. 2-3,	Shoemakersville,	Berks,	Hon. Jason Sexton.
Feb. 4,	Morgantown,	Berks,	Hon. Jason Sexton.
Feb. 5-6,	Schnecksville,	Lehigh,	L. W. Lighty and Oliver D. Schock.
Feb. 7,	Lynnport,	Lehigh,	L. W. Lighty and Oliver D. Schock.
Feb. 9-10,	Centre Valley,	Lehigh,	L. W. Lighty and Oliver D. Schock.
Feb. 11,	New Mahoning,	Carbon,	L. W. Lighty.
Feb. 12,	Weatherly,	Carbon,	L. W. Lighty.
Feb. 13,	Orwigsburg,	Schuylkill,	Hon. R. F. Schwarz.
Feb. 14,	Schuylkill Haven,	Schuylkill,	Hon. R. F. Schwarz.

Date.		Place.	County.	Additional Lecturers.
Feb.	19,	Hegins,	Schuylkill,	Hon. R. F. Schwarz.
Feb.	20,	Pinegrove,	Schuylkill,	Hon. R. F. Schwarz.
Feb.	23-24,	Numidia,	Columbia,	Joel A. Herr.
Feb.	25-26,	Millville,	Columbia,	Joel A. Herr.
Feb.	27,	Benton,	Columbia,	Joel A. Herr.
Feb.	28,	Nescopeck,	Luzerne,	Joel A. Herr.
March	2,	Huntingdon Mills,	Luzerne,	E. S. Hoover.
March	3,	Lehman,	Luzerne,	E. S. Hoover.
March	4,	Orange,	Luzerne,	E. S. Hoover.

LIST OF SPEAKERS AND THEIR ASSIGNMENTS.

FOR THE SEASON OF 1902-1903.

S. F. BARBER, Harrisburg, Dauphin County, Pa.

Town.	County.	Dates.
Glade Run,	Lycoming,	Dec. 29.
Wellsboro,	Tioga,	Dec. 30-31.
Tioga,	Tioga,	Jan. 1-2.
Westfield,	Tioga,	Jan. 5-6.

DR. HARVEY E. BASHORE, West Fairview, Cumberland County, Pa.

Linglestown,	Dauphin,	Dec. 29-30.
Fishersville,	Dauphin,	Dec. 31, Jan. 1.

R. L. BEARDSLEE, Warrenham, Bradford County, Pa.

Germania,	Potter,	Jan. 7-8.
Shingle House,	Potter,	Jan. 9-10.
Emporium,	Cameron,	Jan. 12-13.
Driftwood,	Cameron,	Jan. 14.
St. Marys,	Elk,	Jan. 15-16.
Kersey,	Elk,	Jan. 17.

M. S. BOND, Danville, Montour County, Pa.

Shawmut,	Clearfield,	Jan. 7-8.
Karthaus,	Clearfield,	Jan. 9-10.
McElhattan,	Clinton,	Jan. 12-13.
Lamar,	Clinton,	Jan. 14.
Millheim,	Centre,	Jan. 15-16.

C. W. BRODHEAD, Montrose, Susquehanna County, Pa.

Kirby,	Greene,	Dec. 12-13.
Khedive,	Greene,	Dec. 15-16.
Prosperity,	Washington,	Dec. 17-18.

Town.	County.	Dates.
West Alexander,	Washington,	Dec. 19-20.
Lewistown,	Mifflin,	Feb. 6-7.
Milroy,	Mifflin,	Feb. 9.
Middleburg,	Snyder,	Feb. 10-11.
Selinsgrove,	Snyder,	Feb. 12-13.

DR. CHARLES A. BROWNE, JR., State College, Centre County, Pa.

Will attend meetings in Third Section from December 1 to January 17.

A. L. BRUBAKER, Hogestown, Cumberland County, Pa.

Oakgrove,	Montour,	Feb. 27-28.
McEwensville,	Northumberland,	Mar. 2-3.
Elysburg,	Northumberland,	Mar. 4-5.

PROF. W. A. BUCKHOUT, State College, Centre County, Pa.

Will attend meetings in Second Section from February 19 to March 5.

J. S. BURNS, Clinton, Allegheny County, Pa.

Indiana,	Indiana,	Dec. 31, Jan. 1.
Marion Centre,	Indiana,	Jan. 2-3.
Gypsy,	Indiana,	Jan. 5-6.
Lampeter,	Lancaster,	Jan. 7-8.
Quarryville,	Lancaster,	Jan. 9-10.
Gap,	Lancaster,	Jan. 12-13.
Manoa,	Delaware,	Jan. 14-15.
Lyndell,	Chester,	Jan. 16-17.
Corry,	Erie,	Feb. 4-5.
Girard,	Erie,	Feb. 6-7.
Philipsville,	Erie,	Feb. 9-10.
Tionesta,	Forest,	Feb. 11-12.
Kellettsville,	Forest,	Feb. 13.
Utica,	Venango,	Feb. 20-21.
Breedstown,	Venango,	Feb. 23-24.
Dayton,	Armstrong,	Feb. 25-26.
Grange Hall,	Armstrong,	Feb. 27-28.
Kittanning,	Armstrong,	Mar. 2.

PROF. GEORGE C. BUTZ, State College, Centre County, Pa.

Will attend meetings in Second Section from December 1 to December 20.

GEORGE CAMPBELL, Greene's Landing, Bradford County, Pa.

Town.	County.	Dates.
Forksville,	Sullivan,	Dec. 15-16.
Hughesville,	Lycoming,	Dec. 17-18.
Bottle Run,	Lycoming,	Dec. 19.
Warrensville,	Lycoming,	Dec. 20.

J. T. CAMPBELL, Hartstown, Crawford County, Pa.

Bethel Church,	Allegheny,	Dec. 29-30.
Elizabeth,	Allegheny,	Dec. 31, Jan. 1.
Gibsonia,	Allegheny,	Jan. 2-3.

M. N. CLARK, Claridge, Westmoreland County, Pa.

Barron's Church,	Somerset,	Dec. 12-13.
Somerset,	Somerset,	Dec. 15-16-17.

DR. M. E. CONARD, West Grove, Chester County, Pa.

Cross Roads,	York,	Jan. 26-27.
McAlisterville,	Juniata,	Feb. 23-24.

PROF. WELLS W. COOKE, Washington, D. C.

Will attend all meetings held in Fourth Section.

JOHN W. COX, New Wilmington, Lawrence County, Pa.

Markle,	Westmoreland,	Dec. 1-2.
Harrison City,	Westmoreland,	Dec. 3.
Mount Pleasant,	Westmoreland,	Dec. 4-5.
Uniontown,	Fayette,	Dec. 6.
New Salem,	Fayette,	Dec. 8-9.
Smithfield,	Fayette,	Dec. 10-11.

Z. T. CURE, Jermyn, Lackawanna County, Pa.

Milford,	Pike,	Dec. 29.
Dingman's Ferry,	Pike,	Dec. 30.
Bossardsville,	Monroe,	Dec. 31, Jan. 1.
Gilbert,	Monroe,	Jan. 2-3.

REV. J. D. DETRICH, Flourtown, Montgomery County, Pa.

Town.	County.	Dates.
New Oxford,	Adams,	Dec. 15-16.
Arendtsville,	Adams,	Dec. 17-18.
Bendersville,	Adams,	Dec. 19.
Quarryville,	Lancaster,	Jan. 9-10.
Dillsburg,	York,	Feb. 2-3.

F. E. FIELD, Stonyfork, Tioga County, Pa.

Herrick,	Susquehanna,	Dec. 1.
Jackson,	Susquehanna,	Dec. 2.
New Milford,	Susquehanna,	Dec. 3.
Montrose,	Susquehanna,	Dec. 4.
Rush,	Susquehanna,	Dec. 5.
West Auburn,	Susquehanna,	Dec. 6.
Tompkinsville,	Lackawanna,	Dec. 8.
Clark's Summit,	Lackawanna,	Dec. 9.
Bald Mount,	Lackawanna,	Dec. 10.
Daleville,	Lackawanna,	Dec. 11.
Madisonville,	Lackawanna,	Dec. 12.
Lampeter,	Lancaster,	Jan. 7-8.
Quarryville,	Lancaster,	Jan. 9-10.
Gap,	Lancaster,	Jan. 12-13.
Manoa,	Delaware,	Jan. 14-15.
Lyndell,	Chester,	Jan. 16-17.

JOHN G. FOIGHT, Export, Westmoreland County, Pa.

Indiana,	Indiana,	Dec. 31, Jan. 1.
Marion Centre,	Indiana,	Jan. 2-3.
Gypsy,	Indiana,	Jan. 5-6.

DR. WILLIAM FREAR, State College, Centre County, Pa.

Will attend meetings in Third Section from January 26 to March 2.

D. C. GILLESPIE, New Castle, Lawrence County, Pa.

Tionesta,	Forest,	Feb. 11-12.
Kellettsville,	Forest,	Feb. 13.
Fryburg,	Clarion,	Feb. 18-19.
Callensburg,	Clarion,	Feb. 20-21.
Curllsville,	Clarion,	Feb. 23-24.

PROF. J. M. HANTZ, Merrittstown, Fayette County, Pa.

Town.	County.	Dates.
Centre Point,	Montgomery,	Feb. 18-19.
Cedarville,	Chester,	Feb. 20-21.
King of Prussia,	Montgomery,	Feb. 23-24.
Concordville,	Delaware,	Feb. 25-26.
Westgrove,	Chester,	Feb. 27-28.

JOEL A. HERR, Cedar Springs, Clinton County, Pa.

Bellwood,	Blair,	Jan. 26-27.
Henrietta,	Blair,	Jan. 28-29.
Rock Spring,	Centre,	Jan. 30-31.
Shade Gap,	Huntingdon,	Feb. 2-3.
Trough Creek,	Huntingdon,	Feb. 4-5.
Numidia,	Columbia,	Feb. 23-24.
Millville,	Columbia,	Feb. 25-26.
Benton,	Columbia,	Feb. 27.
Nescopeck,	Luzerne,	Feb. 28.

E. S. HOOVER, Lancaster, Lancaster County, Pa.

Huntingdon Mills,	Luzerne,	Mar. 2.
Lehman,	Luzerne,	Mar. 3.
Orange,	Luzerne,	Mar. 4.

GEORGE E. HULL, Orangeville, O.

Farmer's Valley,	McKean,	Jan. 26-27.
Turtle Point,	McKean,	Jan. 28-29.
Ackley,	Warren,	Jan. 30-31.
Grand Valley,	Warren,	Feb. 2-3.

W. A. HUTCHISON, Jeannette, Westmoreland County, Pa.

Somerton,	Bucks,	Jan. 26-27.
Langhorne,	Bucks,	Jan. 28-29.
Campbelltown,	Lebanon,	Feb. 4.
Jonestown,	Lebanon,	Feb. 5.
Myerstown,	Lebanon,	Feb. 6.
Schaefferstown,	Lebanon,	Feb. 7.
Harleysville,	Montgomery,	Feb. 9-10.
Horticultural Hall,	Philadelphia,	Feb. 11.
Bustleton,	Philadelphia,	Feb. 12-13.
Parkerford,	Chester,	Feb. 14.

A. J. KAHLER, Hughesville, Lycoming County, Pa.

Town.	County.	Dates.
Fryburg,	Clarion,	Feb. 18-19.
Callensburg,	Clarion,	Feb. 20-21.
Curllsville,	Clarion,	Feb.-23-24.
Allens Mills,	Jefferson,	Feb. 25-26.
Paradise,	Jefferson,	Feb. 27-28.

J .H. LEDY, Marion, Franklin County, Pa.

Oakville,	Cumberland,	Dec. 9-10.
Hogestown,	Cumberland,	Dec. 11-12.
Centerville,	Cumberland,	Dec. 13.
Campbelltown,	Lebanon,	Feb. 4.
Jonestown,	Lebanon,	Feb. 5.
Myerstown,	Lebanon,	Feb. 6.
Schaefferstown,	Lebanon,	Feb. 7.

AMOS B. LEHMAN, Fayetteville, Franklin County, Pa.

New Oxford,	Adams,	Dec. 15-16.
Arendtsville,	Adams,	Dec. 17-18.
Bendersville,	Adams,	Dec. 19.

L. W. LIGHTY, East Berlin, Adams County, Pa.

Orrstown,	Franklin,	Dec. 1-2.
Fayetteville,	Franklin,	Dec. 3-4.
Lemasters,	Franklin,	Dec. 5-6.
Greencastle,	Franklin,	Dec. 8.
Oakville,	Cumberland,	Dec. 9-10.
Hogestown,	Cumberland,	Dec. 11-12.
Centerville,	Cumberland,	Dec. 13.
Winfield Grange,	Butler,	Jan. 5-6.
West Sunbury,	Butler,	Jan. 7-8.
Harmony,	Butler,	Jan. 9-10.
New Bedford,	Lawrence,	Jan. 12-13.
Bethel Church,	Lawrence,	Jan. 14-15.
New Galilee,	Beaver,	Jan. 16-17.
Cross Roads,	York,	Jan. 26-27.
Stewartstown,	York,	Jan. 28-29.
Springgrove,	York,	Jan. 30-31.
Dillsburg,	York,	Feb. 2-3.
Schnecksville,	Lehigh,	Feb. 5-6.

Town.	County.	Dates.
Lynnport,	Lehigh,	Feb. 7.
Centre Valley,	Lehigh,	Feb. 9-10.
New Mahoning,	Carbon,	Feb. 11.
Weatherly,	Carbon,	Feb. 12.

JOHN T. McDONALD, Delhi, N. Y.

Centre Point,	Montgomery,	Feb. 18-19.
Cedarville,	Chester,	Feb. 20-21.
King of Prussia,	Montgomery,	Feb. 23-24.
Concordville,	Delaware,	Feb. 25-26.
Westgrove,	Chester,	Feb. 27-28.

PROF. FRANKLIN MENGES, York, York County, Pa.

Will attend meetings in Fifth Section from December 29 to March 4.

C. D. NORTHROP, Elkland, Tioga County, Pa.

Tunkhannock,	Wyoming,	Dec. 1-2.
Laceyville,	Wyoming,	Dec. 3-4.
Leraysville,	Bradford,	Dec. 5-6.
Ulster,	Bradford,	Dec. 8-9.
Troy,	Bradford,	Dec. 10-11.
New Albany,	Bradford,	Dec. 12-13.

HENRY W. NORTHUP, Glenburn, Lackawanna County, Pa.

Mount Bethel,	Northampton,	Jan. 5-6.
Tatamy,	Northampton,	Jan. 7-8.
Lower Saucon,	Northampton,	Jan. 9-10.
Sellersville,	Bucks,	Jan. 12-13.
Pineville,	Bucks,	Jan. 14-15.
Boyertown,	Berks,	Jan. 16.
Geigertown,	Berks,	Jan. 17.

T. E. ORR, Beaver, Beaver County, Pa.

Prosperity,	Washington,	Dec. 17-18.
West Alexander,	Washington,	Dec. 19-20.
Bethel Church,	Allegheny,	Dec. 29-30.
Elizabeth,	Allegheny,	Dec. 31, Jan. 1.
Gibsonia,	Allegheny,	Jan. 2-3.

Town.	County.	Dates.
Harleysville,	Montgomery,	Feb. 9-10.
Horticultural Hall,	Philadelphia,	Feb. 11.
Bustleton,	Philadelphia,	Feb. 12-13.
Parkerford,	Chester,	Feb. 14.

JOHN Y. PATTON, New Castle, Lawrence County, Pa.

Shawmut,	Clearfield,	Jan. 7-8.
Karthaus,	Clearfield,	Jan. 9-10.
McElhattan,	Clinton,	Jan. 12-13.
Lamar,	Clinton,	Jan. 14.
Millheim,	Centre,	Jan. 15-16.

J. H. PEACHY, Belleville, Mifflin County, Pa.

Orrstown,	Franklin,	Dec. 1-2.
Fayetteville,	Franklin,	Dec. 3-4.
Lemasters,	Franklin,	Dec. 5-6.
Greencastle,	Franklin,	Dec. 8.
Newport,	Perry,	Jan. 2-3.
Blain,	Perry,	Jan. 5-6.
Tatamy,	Northampton,	Jan. 7-8.
Lower Saucon,	Northampton,	Jan. 9-10.
Frankfort,	Beaver,	Jan. 27-28.
Jackson Centre,	Mercer,	Jan. 29.
Sandy Lake,	Mercer,	Jan. 30-31.
Hadley,	Mercer,	Feb. 2-3.
Fredonia,	Mercer,	Feb. 4-5.
Hartstown,	Crawford,	Feb. 6-7.
Millers Station,	Crawford,	Feb. 9-10.
Spartansburg,	Crawford,	Feb. 11-12.
Townville,	Crawford,	Feb. 13-14.

HON. THOMAS J. PHILIPS, Atglen, Chester County, Pa.

Will attend all meetings held in Fourth Section.

W. H. H. RIDDLE, Butler, Butler County, Pa.

Bedford,	Bedford.	Dec. 5-6.
Schellsburg,	Bedford,	Dec. 8-9.
Mann's Choice,	Bedford,	Dec. 10.
Barron's Church,	Somerset,	Dec. 12-13.
Somerset,	Somerset,	Dec. 15-16-17.
Scalp Level,	Cambria,	Dec. 18-19.
Carrolltown,	Cambria,	Dec. 29-30.

OLIVER D. SCHOCK, Hamburg, Berks County, Pa.

Town.	County.	Dates.
Schnecksville,	Lehigh,	Feb. 5-6.
Lynnport,	Lehigh,	Feb. 7.
Centre Valley,	Lehigh,	Feb. 9-10.

HON. R. F. SCHWARZ, Analomink, Monroe County, Pa.

Beech Lake,	Wayne,	Dec. 15-16.
Tyler Hill,	Wayne,	Dec. 17-18.
Bethany,	Wayne,	Dec. 19-20.
Cross Roads,	York,	Jan. 26-27.
Stewartstown,	York,	Jan. 28-29.
Springgrove,	York,	Jan. 30-31.
Dillsburg,	York,	Feb. 2-3.
Orwigsburg,	Schuylkill,	Feb. 13.
Schuylkill Haven,	Schuylkill,	Feb. 14.
Hegins,	Schuylkill,	Feb. 19.
Pinegrove,	Schuylkill,	Feb. 20.

ROBERT S. SEEDS, Birmingham, Huntingdon County, Pa.

Will attend all meetings held in Second Section.

HON. JASON SEXTON, North Wales, Montgomery County, Pa.

Strouchsburg,	Berks,	Jan. 30-31.
Shoemakersville,	Berks,	Feb. 2-3.
Morgantown,	Berks,	Feb. 4.

W. H. STOUT, Pinegrove, Schuylkill County, Pa.

McConnellsburg,	Fulton,	Dec. 1.
Needmore,	Fulton,	Dec. 2.
Buck Valley,	Fulton,	Dec. 3.
Warfordsburg,	Fulton,	Dec. 4.
Bedford,	Bedford,	Dec. 5-6.
Schellsburg,	Bedford,	Dec. 8-9.
Mann's Choice,	Bedford,	Dec. 10.
Linglestown,	Dauphin,	Dec. 29-30.
Fishersville,	Dauphin,	Dec. 31, Jan. 1.
Newport,	Perry,	Jan. 2-3.
Blain,	Perry,	Jan. 5-6.

DR. I. A. THAYER, New Castle, Lawrence County, Pa.

Will attend meetings in Fifth Section from December 1 to December 19.

Will attend meetings in Second Section from January 26 to February 14.

F. J. WAGNER, Harrison City, Westmoreland County, Pa.

Uniontown,	Fayette,	Dec. 6.
New Salem,	Fayette,	Dec. 8-9.
Smithfield,	Fayette,	Dec. 10-11.

SAMUEL W. H. WALTZ, Williamsport, Lycoming County, Pa.

Mifflinburg,	Union,	Feb. 19-20-21.
McAlisterville,	Juniata,	Feb. 23-24.
McCoysville,	Juniata,	Feb. 25-26.

PROF. R. L. WATTS, Scalp Level, Cambria County, Pa.

Will attend all meetings held in First Section.

R. J. WELD, Sugargrove, Warren County, Pa.

Will attend all meetings held in Third Section.

COL. JOHN A. WOODWARD, Howard, Centre County, Pa.

Will attend all meetings held in Fifth Section.

GENERAL LIST OF LECTURERS, SPEAKERS AND ESSAYISTS, WITH THEIR SUBJECTS.

1902-1903.

ARMSBY, DR. H. P., Director of Experiment Station, State College, Centre County, Pa.:

1. Corn as a Feeding Stuff.
2. The Choice of Feeding Stuffs.
3. The Cost of a Pound of Butter.
4. What Should the Rural School Teach?
5. The Education of the Farmer.

BARBER, SPENCER F., Box 104, Harrisburg, Dauphin County, Pa.:

1. The Little Mistakes that Make so Much Trouble in the Dairy.
2. The Silo; How to Build One, and How and When to Fill It.
3. Feeding of Dairy Cattle, and How to Balance a Ration.
4. Proper Stabling of Cows.
5. Breeding and Feeding Hogs for Market.
6. How to Put Milk on the Market in the Very Best Condition.
7. Commercial Fertilizers.
8. The Soiling System.

BASHORE, DR. HARVEY B., West Fairview, Cumberland County, Pa.:

1. Hygiene of the Farm.
2. Village Sanitation.

BEARDSLEE, R. L., Warrenham, Bradford County, Pa.:

1. How to Renovate an Impoverished Farm.
2. How to Establish and Maintain a Dairy.
3. Diversified Farming.
4. Fodder, Corn, Silo and Silage.
5. Producing Grass and Making Hay.
6. Potato Culture.

7. Should not the Department of Agriculture, the Farmers' Organizations, the Pennsylvania State College and the Average Farmer of Our State Enjoy the Benefits of a Closer Relationship?

BOND, M. S., Danville, Montour County, Pa.:

1. Necessity of More Intensity in Farming.
2. How the Girls Can Make Money on the Farm.
3. My Success in the Use of Commercial Fertilizers.
4. Potato Raising, with History of Discovery, Etc.
5. The Market Garden on the Farm.
6. Profit Growing Onions.
7. Keeping Accounts on the Farm.
8. Why the Farmers Should Organize.
9. How Can We Reduce Local Taxation. (Not political.) (20 minutes each.)

BRODHEAD, C. W., Montrose, Susquehanna County, Pa.:

1. Horse Shoeing and Anatomy of Foot and Leg, with Specimens. (45 minutes.)
2. Care of Horses' Feet and Teeth, with Specimens. (40 minutes.)
3. Some Things Every One Should Know Who Owns or Handles a Horse. (30 minutes.)
4. Zoology of the Horse; a Nature Study. (Illustrated with chart and specimens.) (30 minutes.)

BROWNE, DR. CHARLES A., JR., State College, Centre County, Pa.:

1. A Few Impressions of Agriculture in Germany.
2. Bacteria and Their Importance to the Farmer.
3. Commercial Fertilizers, and Their Application.
4. Losses on the Manure Pile and How to Prevent Them.

BRUBAKER, A. L., Hogestown, Cumberland County, Pa.:

1. Potato Culture. (15-30 minutes.)
2. The Farmer's Home. (25 minutes.)
3. The Farmer's Education. (30 minutes.)
4. The Farmer's Account Book. (25 minutes.)
5. Other Crops (A plea to the farmer's boy and girl.) (30 minutes.)

BUCKHOUT, PROF. W. A., State College, Centre County, Pa.:

1. The Leaves of Plants and Their Relation to Plant Diseases. (40 minutes.)

2. The Roots of Plants and Their Relation to Plant Diseases. (40 minutes.)
3. Common Sense Methods in the Treatment of Injurious Insects. (40 minutes.)
4. Microbes and How They Affect the Work of the Farmer. (25 minutes.)

BURNS, J. S., Clinton, Allegheny County, Pa.:

1. Breeding and Care of Swine.
2. Sheep Husbandry.
3. Breeding and Care of Cattle.
4. Training the Colt to Harness.
5. Farmers as We Find Them.
6. The Farmer and His Wife.
7. Home Influence. (30-45 minutes.)
8. The Farmer's Accounts.
9. Growing and Preserving Pork for Family Use.
10. Relation of Stock Raising to Farm Fertility.
11. Education for Country Children. (20-30 minutes each.)

BUTZ, PROF. GEORGE C., State College, Centre County, Pa.:

1. Modern Treatment of Apple Orchards.
2. Peach Culture.
3. Fungous Diseases of Fruits.
4. Insect Enemies of Farm and Garden.
5. San José Scale.
6. Ornamentation of Home Grounds.
7. Botany on the Farm.
8. Agricultural Education.
9. Nature Study in Schools.
10. Growing Vegetables and Fruits for Canning Factories. (30 minutes each.)

CAMPBELL, GEORGE, Greene's Landing, Bradford County, Pa.:

1. Sheep Breeding and Feeding for the Show Ring or Market.
2. How to Strengthen and Improve Various Soils.
3. Strawberry Culture and Mushroom Culture. (10 minutes each.)
4. Soiling and Root Feeding of Cattle and Sheep.
5. Fertilizers in Combination with Manure.
6. Principles of Good Road, and How to Make Them.
7. Grasses for Meadows and Pastures, with Soil Preparation.

8. Soil Improvement with Drainage and Legumes.
9. Improvement and Selection of Dairy Cattle.
10. That Gem, the Farm Girl. (20 minutes each.)

CAMPBELL, J. T., Hartstown, Crawford County, Pa.:

1. Construction of Poultry Houses and Fixtures. (25 minutes.)
2. Profitable Egg Production. (20 minutes.)
3. The Vermin Pest. (15 minutes.)
4. The Chemical Legume Combination for Improving Poor Land. (20-25 minutes.)
5. The Improvement of a Run-Down Farm. (20 minutes.)
6. Heating the Farm House. (20 minutes.)

CLARK, M. N., Claridge, Westmoreland County, Pa.:

1. Buying and Care of Farm Implements. (20 minutes.)
2. Growing and Marketing Swine. (25 minutes.)
3. The County Fair and the Fakir. (15 minutes.)
4. Every Farmer Should Belong to the Grange. (25 minutes.)
5. The Up-to-Date Farmer. (15 minutes.)
6. The Hired Help on the Farm. (20 minutes.)
7. The Farm Journal for the Farmers' Home. (25 minutes.)

CONARD, DR. M. E., Westgrove, Chester County, Pa.:

1. An Inexpensive Up-to-Date Cow Stable.
2. How to Produce Pure and Wholesome Milk.
3. How to Grow and Care for Horses' Feet.
4. How Shall We Replenish Our Dairy Herds?
5. Some Facts About the Care of Farm Teams.
6. Some Neglected Points in the Feeding of Calves.

COOKE, PROF. WELLS W., 1328 Twelfth Street, N. W., Washington, D. C.:

1. The Effect of Feed on the Quantity and Quality of Milk.
2. Relative Value of Stock Foods.
3. Care and Feeding of Dairy Stock.
4. Handling Milk and Butter Making.
5. Feeding from the Silo Throughout the Year.
6. The Growing and Preservation of Forage Crops.
7. The Value of Farm Manure and How to Retain It.
8. Shall we Fertilize the Land or the Crop?
9. Feeding the Human Animal.
10. Household Conveniences.
11. Nature Study in the Country School.

COX, JOHN W., New Wilmington, Lawrence County, Pa.:

1. Soil Fertility and the Preparation of the Seed Bed.
2. Maintaining Soil Moisture and Vegetable Matter in the Soil.
3. Poultry Raising and Feeding for Profit.
4. Easiest and Most Profitable Way to Grow Potatoes.

CURE, Z. T., Jermyn, Lackawanna County, Pa.:

1. Corn Culture.
2. Production and Care of Orchards.
3. Potato Culture. z
4. The Economic Use of Commercial Fertilizers.
5. Education of the Farmer a Necessity. (25-30 minutes.)
6. The Handling of Sheep and Production of Early Spring Lambs.
7. How the Raising of Colts may Be a Profitable Adjunct to General Farming. (15-20 minutes each.)

DETRICH, REV. J. D., Flourtown, Montgomery County, Pa.:

1. How to Keep Twenty Head or More of Dairy Animals on Fifteen Acres.
2. Eighteen Years Experience in Soiling.
3. Sixteen Years Experience with a Wooden Silo.
4. Shall we Grow Crops on a Fifteen-Acre Farm and No Fertilizer.
5. Feed, Breed and Care of the Dairy.
6. Breeding and Raising the Dairy Animal.
7. The Agricultural College and the Farmer.
8. The Farmer's Waste Basket.
9. The Small Farm vs. the Large Farm.
10. Bench, Book and Farm.

FIELD, F. E., Wellsboro, Tioga County, Pa.:

1. Planting and Taking Care of an Orchard.
2. Potato Culture.
3. Elementary Chemistry.
4. Geology. (30-40 minutes.)
5. Milk.
6. Chemistry of Plants and Fertilizers. (30-60 minutes.)
7. The Proper Education for a Farmer's Boy. (30 minutes each.)

FOIGHT, JOHN G., Export, Westmoreland County, Pa.:

1. American Agriculture.
2. The Farmer of To-Day.
3. Success in the Dairy.
4. Small Fruits on the Farm.
5. Farm Literature.
6. Farmers' Homes.
7. Our Boys and Girls the Best Products of our Farms. (20-30 minutes each.)

FREAR, DR. WILLIAM, Professor of Agricultural Chemistry, and Chemist of Board of Agriculture, State College, Centre County, Pa.:

1. Improvement of Soil.
2. The Waste from the Stable and Barnyard.
3. Lime and Its Uses.
4. Commercial Fertilizers.
5. Clover Crops in Our Rotations.
6. Soil Cultivation and Soil Moisture.
7. The Principles of Stock Feeding.
8. The Sugar Beet in Pennsylvania.
9. Vinegar Making.
10. Meat and Its Cooking.
11. Wheat, Flour and Bread.
12. Education for the Adult Farmer.

FRIES, J. A., State College, Centre County, Pa.:

1. Relation of Lime and Marl to Agriculture.
2. Loss of Nitrogen in Barn Yard Manure, and How to Prevent It.
3. The Barn Yard.

GILLESPIE, D. C., New Castle, Lawrence County, Pa.:

1. American Homes—Best National Defense. (25-30 minutes.)
2. How Can the Boys be Kept on the Farm? (20-25 minutes.)
3. Experience with a Fertilizer on Sterilized Ground. (10-15 minutes.)
4. Planting Potatoes. (10-15 minutes.)
5. The Log School House; or, Then and Now.

HANTZ, PROF. J. M., Merrittstown, Fayette County, Pa.:

1. The Idea of True Education. (35 minutes.)
2. Dairying.

3. Potato Culture.
4. Wheat Culture.
5. Growing Strawberries and Raspberries.
6. Money in Poultry.
7. How to Build Up a Run-Down Farm.
8. Our Homes. (Evening lecture.) (35 minutes.)
9. The Dairy Cow.
10. Fertility and Tillage. (About 25 minutes each.)

HERR, JOEL A., Cedar Springs, Clinton County, Pa.:

1. Feeding and Care of Cattle.
2. Fertility.
3. Fruit Growing.
4. Farmers' Accounts.
5. Specialties in Farming.
6. Graded Schools.
7. Practical Road Making.
8. The Bright Side of Farm Life.
9. Selection and Care of Milch Cows.
10. Education Through Organization.

HOOVER, HON. E. S., Lancaster, Lancaster County, Pa.:

1. Cultivation of the Tobacco Plant; Its Proper Curing, Handling and Preparation for Market.
2. Incentives to Farming.
3. Failure in Farming and the Causes.
4. System on the Farm.
5. Farming the Chief Support of the Nation.
6. Farmers' Institutes; Their Importance and Benefits.
7. Soil Improvement.
8. Care of Farm Crops.
9. Proper Use and Care of Farm Machinery.
10. The Horse; His Breeding, Rearing and Training.
11. Beautifying Home Grounds. (15-20 minutes each.)

HULL, GEORGE E., Mercer County, Pa. (P. O., Orangeville, O.):

1. Marking Marketable Butter from a Few Cows. (25 minutes.)
2. The Farm Creamery. (25 minutes.)
3. Construction and Filling of Silos. (25 minutes.)
4. Construction of a Dairy Barn. (20 minutes.)
5. Marketing Farm Products. (15 minutes.)
6. The Farm Water Supply. (15 minutes.)

HUTCHISON, G. G., Warriors' Mark, Huntingdon County, Pa.:

1. The Adulteration of Food. (20 to 25 minutes.)
2. Potato Culture. (20 to 30 minutes.)
3. The Best Way to Build Up a Poor Farm in Pennsylvania. (20 to 30 minutes.)

HUTCHISON, W. A., Jeannette, Westmoreland County, Pa.:

1. A Modern Dairy Farm.
2. Silos and Silage.
3. Soil Fertility—How Cheapest to Get and Maintain.
4. Care and Feeding of the Dairy Cow.
5. Our Country Homes.
6. The Young Farmer.
7. The Profitable Orchard. (20 minutes each.)

KAHLER, A. J., Hughesville, Lycoming County, Pa.:

1. The Road Problem.
2. How to Increase the Fertility of Worn Out Farms.
3. Equalization of Taxation.
4. District High Schools.
5. My Experience with Commercial Fertilizers.
6. Soil Improvement.
7. Corn Culture.
8 Stock Raising.

LANDIS, HON. JOHN H., Millersville, Lancaster County, Pa.:

1. Neglected Opportunities. (10-15 minutes.)
2. Patriotism on the Farm. (10-15 minutes.)
3. The Pennsylvania Farmer and His Future. (10-15 minutes.)

LEDY, J. H., Marion, Franklin County, Pa.:

1. General Fruit Growing; How to Take Care of Trees.
2 Peach, Apple and Plum Culture.
3. Pruning, Cultivation and Fertilizing the Orchard.
4. The Farmer's Garden.
5. Alfalfa; Its Value and How to Grow It.
6. Small Fruit Culture.
7. Tomatoes and Cantaloups; How to Grow Them.
8. Poultry for Profit, and How to Make Hens Lay.
9. Roads and Road Taxes. (20 minutes each.)

LEHMAN, AMOS B., Fayetteville, Franklin County, Pa.:

1. How I made $356 Feeding Twenty-six Steers Five and One-Half Months.
2. How I Maintain a Family of Twelve on Forty-five Acres. (Humorous.)
3. The Great Help Farmers' Institutes Have Been to Me.
4. Growing Corn and Peas for the Silo; a Balanced Ration.
5. What I Saw at State College, and Why the Farmers of Pennsylvania Should Demand Sufficient Appropriations to Make It the Peer of any in the State.
6. Breeding, Feeding and Profit in Hogs.

LIGHTY, L. W., East Berlin, Adams County, Pa.:

1. The Farmer's Cow.
2. Making and Selling Fine Dairy Butter.
3. Silo Experience and Practice.
4. Soiling and Soiling Crops.
5. Culture and Feeding of the Corn Crop.
6. Value, Care and Application of Farm Manure.
7. The Home Garden.

McDONALD, JOHN T., Delhi, N. Y.:

1. Successful Dairy Farming.
2. Why Dairy Farmers Should Do Without Poultry.
3. Value of Skim Milk on the Farm.
4. Steaming Food for the Dairy. (25 minutes each.)

McDOWELL, M. S., State College, Centre County, Pa.:

1. Commercial Fertilizers.
2. Lime and Its Action.
3. Soil Moisture.
4. Barnyard Manure.
5. Why Educate?

MENGES, PROF. FRANKLIN, York, York County, Pa.:

1. The Advantages of a Knowledge of Chemistry to the Farmer.
2. Fixation of Free Nitrogen Explained.
3. Nitrification; Conditions Necessary to Produce It.
4. The Maintenance of Soil Moisture.
5. Rotation of Crops as a Means for Conserving Soil Fertility.
6. Field Trials with Fertilizer and Verification of Results.
7. The Feeding Powers and Habits of Some Agricultural Plants.

8. Need of Education for the Farmer Compared with other Vocations.
9. The Value of Our Native Birds to the Farmer.
10. Insect Friends and Foes of the Farmer. (20-30 minutes each.)

NORTHROP, C. D., Elkland, Tioga County, Pa.:

1. Feeding and Care of the Dairy Cow.
2. Making and Marketing Gilt-Edged Butter.
3. The Babcock Test in the Dairy and How to Use It.
4. The Farmer's Corn Crop and the Silo.
5. Potatoes and How to Grow Them.
6. Farm Fertility; Experience with Run-Down Farms.
7. Education for Farmers' Children.
8. Making a Home in the Country.
9. The Wife a Partner. (20-30 minutes each.)

NORTHUP, HENRY W., Glenburn, Lackawanna County, Pa.:

1. Selection, Care and Management of the Dairy. (30 minutes.)
2. Practical Experience with the Silo. (30 minutes.)
3. Potato Growing. (20 minutes.)
4. The Exhaustion and Restoration of Our Soil. (30 minutes.)
5. Fruit Culture. (20 minutes.)
6. Farm Products and How to Market Them. (20 minutes.)
7. Nature Study for Country Schools. (20 minutes.)
8. Educating the Farmer and Increasing his Usefulness. (20 minutes.)
9. Desirable Country Homes and How to Enjoy Them. (20 minutes.)

OLIVER, M. W., Conneautville, Crawford County, Pa.:

1. Fertility and Exhaustion.
2. Economy in Farming.
3. The Cow, and What is Her Due?
4. What Makes a Home?
5. Culture in the Farm Home.

ORR, T. E., Beaver, Beaver County, Pa.:

1. Poultry as a Side Line for Farmers.
2. Poultry Raising as a Business.
3. Poultry Houses and Yards.
4. The Breed or the Feed?
5. Your Youth and Mine on the Farm.

6. The Smallest but Most Useful Implement.
7. The Hand, Head and Heart in Farming.
8. One Thing Our Common Schools Should Do. (30-40 minutes each.)

PATTON, JAMES Y., New Castle, Lawrence County, Pa.:

1. Winter Eggs. (20 minutes.)
2. Breeding and Feeding Poultry. (20 minutes.)
3. Care and Application of Manure. (20 minutes.)
4. Preserving Soil Moisture. (20 minutes.)
5. Silos and Silage. (15 minutes.)
6. How to Grow Good Clover. (15 minutes.)

PEACHY, J. H., Belleville, Mifflin County, Pa.:

1. The Farmer's Boy; His Education.
2. Half Hour in the Corn Field.
3. Hogs for Profit.
4. Soil Improvement.
5. Care of Farm Animals.
6. Nature Study in the Public Schools.
7. Butter Making on the Farm.
8. The Inside of the Farmer's Home.
9. Strawberry Culture.
10. The Making of a Farmer. (20-30 minutes each.)

PHILIPS, HON. THOMAS J., Atglen, Chester County, Pa.:

1. The Silo an Economic.
2. Renewed Fertility; How to Get It.
3. Lime; Do You Need Some?
4. Profit or Loss in the Dairy.
5. Commercial Fertilizers; Their Nature and Use.
6. Intelligent Feeding.
7. The Farmer's Garden.
8. Higher Education for Farmers' Children.
9. How Shall We Study and Teach From Nature?
10. The Wife's Share.

RIDDLE, W. H. H., Butler, Butler County, Pa.:

1. Commercial Fertilzers; Their Composition and Value to the Farmer.
2. Experimental Work on the Farm.
3. Our Agricultural Colleges.

4. The Proper Uses of Lime in Agriculture.
5. The Home and Its Surroundings.
6. Pure Bred Stock on the Farm.
7. The Outlook of the Modern Farmer.
8. The Relation of Counties to the State Treasury.
9. The Value of the Poultry Interest.

SCHOCK, OLIVER D., Hamburg, Berks County, Pa.:

1. Poultry on the Farm.
2. Good Local Government.
3. Making Farmers' Homes Attractive.
4. Amateur Grape Culture.
5. The Family Garden.
6. Floriculture in the Country.
7. The Responsibilities of Farmers.
8. Progress in Agriculture.
9. The Farmers' Institute in Pennsylvania.

SCHWARZ, HON. R. F., Analomink, Monroe County, Pa.:

1. Market Gardening and Small Fruit Growing. (15-40 minutes.)
2. Success with Crimson Clover and Vetches. (25-40 minutes.)
3. The Economical Use of Fertilizers. (30 minutes.)
4. Finding a Market and Properly Marketing Produce. (20-40 minutes.)
5. Education a Necessity for the Modern Farmer. (Evening lecture;35-60 minutes.)
6. The Economy of Good Tools and Their Use. (20 minutes.)
7. Vegetables and Fruits for the Farmer's Table. (Evening lecture, if desired; 40 minutes.)

SEEDS, R. S., Birmingham, Huntingdon County, Pa.:

1. Value of Fertility and Cheapest Way to Get It. (30-40 minutes.)
2. What Constitutes a Country Home? (30-40 minutes.)
3. Education and the Farmer. (30 minutes.)
4. Benefits Derived from Farmers' Institutes. (20 minutes.)
5. What I Know About Roads. (20 minutes.)
6. Soil Improvement, the Keynote of Agriculture. (30 minutes.)
7. Mistakes of Life Exposed. (E. L.) (60 minutes.)

SEXTON, HON. JASON, North Wales, Montgomery County, Pa.:

1. Sheep Husbandry. (30 minutes.)
2. The Production of Lambs for Early Market. (30 minutes.)

3. How Farming Can Be Made to Pay.
4. Why Farmers Should Encourage Road Improvement.
5. What is Successful Farming? (30 minutes.)
6. Our Wasted Resources. (30 minutes.)
7. How to Make the Dairy a Success. (30 minutes.)
8. Why the Elements of Agriculture Should be Taught in Our Public Schools. (30 minutes.)

STOUT, W. H., Pinegrove, Schuylkill County, Pa.:

1. Fruit Growing.
2. Experience in Draining.
3. Theory vs. Practice.
4. Marketing Perishable Products.
5. The Care and Use of Stable Manure.
6. Commercial Fertilizers and Compounds.
7. The Farmer Himself His Greatest Enemy. (30 minutes each.)

SURFACE, PROF. H. A., State College, Centre County, Pa.:

1. The Economic Value and Protection of Our Native Birds. (40-50 minutes.)
2. General Principles and Methods of Insect Warfare. Illustrated.* (45 minutes.)
3. The Hessian Fly in Pennsylvania. Sometimes illustrated by lantern.* (20 minutes.)
4. Nature Study and Agriculture in the Public Schools. (25-30 minutes.)
5. The Centralization of Schools. (20 minutes.)
6. Higher Education for Farmers' Boys and Girls. (15-25 minutes.)
7. What the Pennsylvania State College Offers to Students. 15-25 minutes.)

THAYER, DR. I. A., New Castle, Lawrence County, Pa.:

1. Benefits of Tile-draining.
2. How to Tile-drain.
3. Soil Moisture.
4. Preparation of the Seed-bed. (40 minutes.)
5. Stable Manure.
6. Commercial Fertilizers.
7. The Clovers as Food.
8. The Clovers as Fertilizers.
9. Potato Culture.

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*When these are desired as evening subjects they will be illustrated by lantern slides.

10. Strawberry Culture.
11. Feeding and Care of Farm Animals.
12. Bovine Tuberculosis.
13. Home Hygiene.
14. Nature Studies. (20-30 minutes each.)

WAGNER, F. J., Harrison City, Westmoreland County, Pa.:

1. Soils and Soil Making.
2. A Balanced Ration for Farm Stock.
3. The Business Side of Farming.
4. The Advantages of the Cream Separator.
5. Clover and Its Place on the Farm.
6. A Solution of the Farm Labor Problem. (15-20 minutes each.)

WALTZ, SAMUEL W. H., Williamsport, Lycoming County, Pa.:

1. The Apiary. (Illustrated.) (20-60 minutes.)
2. "Home, Sweet Home."
3. The Apple Orchard. (Illustrated.)
4. Profitable Poultry Keeping. (Illustrated.)
5. Our Insect Friends and Foes. (Illustrated.)
6. The Culture and Value of Clover. (Illustrated.)
7. The Ideal Cow; Her Fare, Her Care, Her Ware.
8. Some Common Birds, and Their Relation to Agriculture. (Illustrated.)
9. My Bird Neighbors; How to Protect and Attract Them. (Illustrated.)
10. Is the Common School Supplying the Proper Education Needed by Farmers' Boys and Girls? (20-30 minutes each.)

WATSON, PROF. GEORGE C., Professor of Agriculture at the Pennsylvania State College, Centre County, Pa.:

1. Poultry Breeding and Feeding for Profit.
2. Agricultural Education.
3. Plant Food and How to Get It.
4. Improved Breeds and Improved Methods of Feeding.
5. Conservation of Moisture in Cultivated Lands.
6. Some Lessons from European Agriculture.

WATTS, PROF. R. L., Scalp Level, Cambria County, Pa.:

1. How Plants Feed and Grow. (30 minutes.)
2. Conservation of Soil Moisture. (30 minutes.)
3. Care and Management of Orchards. (30 minutes.)

4. Apples in Pennsylvania. (30 minutes.)
5. The Cultivation of Small Fruits. (30 minutes.)
6. Market Gardening. (30 minutes.)
7. Nature Study in the Public Schools. (30 minutes.)
8. Beautifying the Home Grounds. (30 minutes.)
9. Opportunities and Advantages for Young Men on the Farm. (30 minutes.)
10. Mental Equipment for Farming. (30 minutes.)

WELD, R. J., Sugargrove, Warren County, Pa.:

1. The Rotation of Crops as a Means of Improving the Fertility of the Farm.
2. Improving the Dairy.
3. Feeding and Managing the Dairy.
4. Butter Making on the Farm.
5. Cheese Making on the Farm.
6. The Tent Caterpillar.
7. Attractive Country Homes.

WHITE, H. V., Bloomsburg, Columbia County, Pa.:

1. Economical Feeding. (20 minutes.)
2. Soil Fertility the Basis of Agricultural Success. (20 minutes.)
3. Nature Studies in the Country Schools. (20 minutes.)
4. Make the Country Home Attractive and Comfortable. (20 minutes.)

WOODWARD, COLONEL, JOHN A., Howard, Centre County, Pa.:

1. What Education Does the Farmer Need?
2. Dairying as a Business Way of Farming.
3. Emphasis in Farming.
4. Care-Taking Worth Hard Cash.
5. Proportion on the Farm.
6. Feeding for a Purpose. (Demonstrated by Charts.) With Special Reference to Dairying.
7. Road Officers and Road Taxes.
8. Make the Country Home Convenient and Comfortable.
9. Some Thoughts upon Farm Fertility and Fertilizing.
10. The Horse as a Factor in Farming.
11. The Soil; Its Care and Culture.

NOTE.

In so far as time and circumstances will permit, the officers of the Department of Agriculture are desirous of engaging in Institute work.

In order to prevent disappointment in the arrangement of programmes, it is recommended that Institute Managers first consult the individual whose services they may wish to secure, before placing his name on the programme.

Department lecturers come to these Institutes free of charge, except that they are to be taken from and to the railroad station at the expense of local manager. The copies which they will discuss can be procured by addressing the following officers of the Department of Agriculture.

DEPARTMENT LECTURERS.

HON. JOHN HAMILTON, Secretary of Agriculture.

HON. A. L. MARTIN, Director of Institutes.

MR. JESSE K. COPE, Dairy and Food Commissioner.

MR. BENJ. F. MacCARTNEY, Economic Zoologist.

DR. LEONARD PEARSON, State Veterinarian.

Biographical Sketches of the Institute Lecturers.

H. P. ARMSBY was born at Northbridge, Mass., in 1853, was educated at the public schools and high schools of his native county, afterwards at Worcester Polytechnic Institute, Sheffield Scientific School of Yale University, and the University of Leipsig. Was instructor in chemistry in the Worcester Polytechnic Institute; teacher in the high school, Fitchburg, Mass.; instructor in chemistry in Rutgers College, N. J.; chemist to Connecticut Experiment Station, 1877-81; vice-principal of Storm Scientific School, Conn., 1881-3; professor agricultural chemistry, University of Wisconsin, 1883-1887; director of the State Experiment Station, State College, Pa., 1887-1898. He is the author of a scientific work on "Cattle Feeding," and the dean of the School of Agriculture at the Pennsylvania State College.

S. F. BARBER was born in Union county, Pa., in 1885, was educated in the public schools and worked upon a farm until he was twenty-one. He then went into the mercantile business; 1877-8 was in the employ of the Buck Mountain Coal Company, in Luzerne county, as general manager of their company store, and in 1879-80 was in charge of the company store of the Stout Coal Company. Afterwards traveled in the west, particularly in Colorado, and then spent one year traveling for a dry goods firm in Philadelphia. In 1881 he settled down to farming, and has been engaged in that business ever since. His specialty is dairying, although he raises the general crops usual upon a Dauphin county farm.

DR. HARVEY BASHORE was born at West Fairview, Pa., July 31, 1864; attended Harrisburg Academy; graduated at Yale College 1886; graduated in medicine at University of Pennsylvania 1889, and spent three years in New York city studying hygiene and working in the various city hospitals; since then has been practicing medicine in West Fairview, a suburb of Harrisburg; was appointed inspector for the State Board of Health, and is author of "Outline of Rural Hygiene."

R. L. BEARDSLEE, of Warrenham, Pa., was born in 1835, received a liberal academic education, and among the studies pursued was a course in "Practical Agriculture." He began farming for himself at twenty years of age, as a dealer in cattle, and followed feeding and dealing in cattle until about 1864. He then included sheep in his stock business, and continued in this until the western trade reduced the profits, when he began dairying and put in forty cows. He has received as high as $1,000 for a single load of butter. He raises from 1,600 to 1,800 bushels of grain each year, and sells about 1,000 pounds of washed wool and 150 lambs annually, besides from 1,000 to 1,200 bushels of potatoes.

M. S. BOND was born on a farm in Montour county, Pa., February 26, 1834; lived and worked on a farm until eighteen years old, then taught school seven years; then employed as freight and passenger conductor for nine years, and traveled as lost freight and car tracer and purchasing agent for the Delaware, Lackawanna and Western Railroad Company for five years. Has been for over twenty-five years engaged in farming and market gardening; during a part of this time, engaged in breeding and raising blooded Jersey cattle and still keeps some of the best in the State; has made the raising of potatoes by the thousands of bushels a specialty for twenty-five years; has been and is now using more fertilizer to the acre than any man in his county, and is now making gardening a specialty.

JOHN F. BOYER was born in Snyder county, Pa., in 1858; had a common school education, and later, provided himself with a good library of agricultural books, which he carefully studied. He is a fruit grower, making peach growing a specialty. During the spring of 1897 he planted 7,000 trees, and in 1898, 12,000 more. He sells some of his fruit as high as $3.00 per bushel.

C. W. BRODHEAD was born December 20, 1852, near White Haven, Luzerne county Pa. He received a common school education; commenced to work in a horse shoeing and jobbing shop at 16 years of age; worked six years at the business before he knew anything about a horse's foot; then began to study anatomy and to dissect feet and legs, and has been a student of the best authors and in actual practice ever since; has one of the best libraries on animals and agriculture that can be had; is a registered specialist as a veterinary dentist and in animal castrations. He divides his time, in the shop, in the care of a ten-acre vegetable garden, and reading for general information; takes great interest in farmers' organizations, trying to elevate their calling.

A. L. BRUBAKER was born on his father's farm in Lancaster county, Pa., in 1863. In 1871 the family removed to a farm near Mechanicsburg, Pa., where he worked during the summer and attended school in the winter until twenty-one years of age. He received a good common school education, which was supplemented by several terms at a select school. He has taught country and village schools for fifteen terms, at the same time managing a farm and working on it in the summer. By close application he has built for himself a fine home, where he gives his attention chiefly to wheat and potato growing.

WILLIAM A. BUCKHOUT was born at Oswego, New York, in 1846, attended the public schools at that place until 1864, when he entered the Pennsylvania Agricultural College. Upon his graduation in 1868 he entered the post-graduate course in botany. From 1869 to 1871 he was engaged in farming near Oswego, N. Y.; was then engaged as instructor in natural sciences by the Pennsylvania State College; was afterwards elected professor of botany in that institution, which position he has filled ever since. He was appointed by the Governor a member of the State Forestry Commission, and is also a member of the scientific staff connected with the State Experiment Station.

J. S. BURNS was born February 22, 1847, on the farm he now owns, near Clinton, Pa. His father died when he was ten years old, and from that time until he was twenty-one he worked upon the farm as hired help, receiving his board and clothing, and attending the public schools in the winter. His education received a brief finish in Linnean Academy, at Clinton.

He was married when twenty-two, and soon after bought out the other heirs, and from the farm made the money that eventually paid for it. He has kept strict account of every item of income and expense since he was twenty-one years old, and to this habit of careful accounting he attributes much of his success. He has had large experience in the breeding and care of all lines of farm stock. But during recent years has given more special attention to the breeding of Poland-China swine, and raising mutton lambs, together with the growing of all the different crops usually raised on a western Pennsylvania farm. He has had considerable experience as a correspondent upon agricultural topics, and for a number of years has taken an active part in the institute work of this State.

GEORGE C. BUTZ was born in 1863, in New Castle, Pa.; his father was a nurseryman and florist. His education consisted of a common, though excellent, public school and later of a course through the high school. After this he was graduated from the Pennsylvania State College, in the class of '83. This was followed by post-graduate studies, and two years' experience in the fruit districts of Southern California. Since 1887 he has had charge of the horticultural work at the Pennsylvania State College and the State Experiment Station. For the past three winters he has been one of the regular lecturers upon the State institute force.

GEORGE CAMPBELL, of Greene's Landing, Pa., was born in Scotland. His father was a market gardener and trained his son in that business until he was competent to take charge of it. The son enlisted with the Royal Engineers, and for three years assisted in making a topographical survey of Scotland. He afterwards became assistant to the steward of the Duke of Buckingham's estate, and later was steward of one of the finest stock farms of Scotland, comprising 1,500 acres. He came to this country forty years ago, cleared a farm and paid for it out of its own production. From 1868 to 1873 he ran a nursery which proved to be a very successful venture, and in his later years he has been attending to his farm and studying the best ways and means to run a farm successfully.

J. T. CAMPBELL was born in Springhill township, Fayette county, Pa., December 18, 1872; is the son of a prominent farmer; received his early education in the public schools of his native district; left the public schools with a more than average education, and at once took up the study of agriculture at home, while working on his father's farm; he studied carefully all leading books and journals of his day. Married in 1894, and took up gardening and poultry culture, and was successful from the start. When the Pennsylvania State College started its Correspondence Course in Agriculture, he took up the work and has since pursued same with diligence. Owns a large farm in Crawford county, upon which he has worked out many important agricultural problems; in poultry culture has been especially successful, having made it a subject of special study, together with soil physics. Keeps in close touch with the State Experiment Station and the National Department of Agriculture; has written some for various agricultural and poultry journals.

M. N. CLARK was born near Export, Westmoreland county, Pa., July 16, 1848; received a good common school education, with several years at an academy and a full course at Duff's Commercial College, at Pittsburg; has always taken much delight in farming; is a close observer, and for many years has taken an active interest in agricultural affairs of his county; the cause of education has always found in him an earnest supporter; has been engaged in general farming from boyhood, except a few years spent in selling implements; was several seasons in the fruit-growing regions of the south, and there gained much information in the use of commercial fertilizers and fruit growing; has been a member of the State Board of Agriculture for six years, and at present is farming and growing swine.

WELLS W. COOKE was born in Massachusetts and educated at the public schools, the University of Iowa, Ripon College, Ripon, Wis., where he graduated in 1879, and the University of Vermont, in which latter institution he took a post-graduate course in chemistry. Had charge for four years of industrial farm schools in the west, and in 1886 was appointed professor of agriculture of the University of Vermont and director of the Vermont Experiment Station, holding both positions until 1893. During this time, for six years, had charge of the organizing and conducting of the farmers' institutes of the State. From 1893 to 1900 was professor of agriculture of the Colorado Agricultural College. The past year has been connected with work of the Correspondence Course in Agriculture at the Pennsylvania State College.

JOHN W. COX was born near New Wilmington, Lawrence county, Pa., December 27, 1868; received a common school education and a course at Duff's Commercial College, Pittsburg; has spent all his life on the farm; is a breeder of Jersey cattle on his 200-acre farm, besides Barred Plymouth Rock poultry; wheat, oats, corn, hay and potatoes are his principal crops; is much interested in the education of the farmers' children, and is serving his third three-year term as school director; is pursuing the Correspondence Course of the Pennsylvania State College.

Z. T. CURE was born in 1848, and attended the public schools, including the city high school until seventeen years of age, after which he taught school for five years, and has followed farming and stock raising ever since. His school training has been supplemented by extensive reading courses, which, by the aid of free translations covered the subjects taught in college courses, with the exception of higher mathematics. As sources of information on the topics which he discusses, he depends upon experience and observation, aided by Prof. L. H. Bailey, of Cornell University, in the domain of horticulture and kindred subjects, and Andrew S. Fuller on the propagation of plants, etc., and other publications of authority, together with a careful perusal of the best agricultural periodicals of the day and a studious consultation of the latest bulletins of the Experiment Stations. He has had considerable experience in the discussion of literary and scientific subjects before teachers' institutes, and has made a careful study of the topics chosen to present at Farmers' Institutes.

REV. J. D. DETRICH'S knowledge of agriculture as a science dates from 1882, since which time he has been availing himself of all the bulletins, magazines and books relating to soil, crops, dairying, breeding, feeding and rearing of dairy animals. This, together with information furnished by the College and Experiment Stations, he has put into practice, and the result has been a satisfactory and profitable system of intensive farming.

HENRY TORSEY FERNALD, born in Maine; early education by private instruction and University of Maine; B. S., 1885; M. S., 1888; 1885-6 graduate work in biology at Wesleyan University, Conn.; 1887-90, John Hopkins University; Ph. D., Johns Hopkins University, 1890; instructor there, 1889-90; professor of zoology, Pennsylvania State College, 1890; member Society of Naturalists of Eastern United States, American Morphological Society and Association of Economic Entomologists. Was Economic Zoologist of Pennsylvania, and is now a member of the Faculty in Amherst College, Mass. Has made special study of the habits and methods of treatment of injurious insects.

F. E. FIELD was born in Tioga county, Pa., on a farm owned by his great grandfather more than a hundred years ago; was educated in the district and Wellsboro high schools; at the age of 21 he engaged in teaching school in Bradford county for a number of years; in the year 1885 returned to his old home near Wellsboro, bought a farm, managed it for three years and accepted a position to take charge of a large tobacco farm of General J. B. Niles. Has served as master of the Niles Valley Grange; was elected assistant steward of the State and lecturer of the County Grange; has served for four years as a member of the Board of Agriculture; is an active Institute worker, and is at present living on his own farm, engaged in the manufacture of cheese, and has made a special study of chemistry, geology, etc.

JOHN G. FOIGHT was born on his father's farm in Westmoreland county, Pa., in 1842; was educated in the public schools and at Laird Institute, Marysville, Pa.; enlisted in company F, 204th Pa. Vols., August, 1864; discharged at close of war at Vienna, Va. He began farming for himself in 1868, and has been actively engaged at it ever since, with average crops about as follows, each year: 600 bushels wheat, 800 bushels oats, 1,200 bushels corn, 400 bushels potatoes, 100 tons hay, and ships to the city $1,000 worth of milk per year, from 12 to 14 fine shorthorn and Ayrshire cows.

WILLIAM FREAR was born in 1860, in Reading, Pa. He was educated in the public schools of that city and of Norristown, entered the preparatory and later the collegiate department of Bucknell University, graduating in 1881; pursued a post-graduate course at Illinois, Wesleyan and Harvard Universities. Spent the growing season of the year during his childhood and youth at work upon a Pennsylvania farm; was made assistant chemist to the United States Department of Agriculture, 1883-5, and was engaged in sugarbeet production and cereals. In 1855 he was elected professor of agricultural chemistry in the Pennsylvania State College, and in 1887 was made vice-director and chemist to the Pennsylvania State College Experiment Station. In 1888 he was elected chemist to the Pennsylvania Board of Agriculture, and in 1895 chemist to the Pennsylvania Department of Agriculture. He was also president of the National Association of Agricultural Chemists, and has been one of the leading lecturers upon the State force of farmers' institute lecturers.

J.A.FRIES was born in Helsinburg, Sweden, in 1863, and received his early education in the public schools and college preparatory school of that place. He took a two years' special course in agriculture at the Pennsylvania State College, 1887-1889, and studied agriculture and chemistry, 1894-1895, at the University in Halle, Germany. Since 1889 he has been engaged as assistant chemist at the Agricultural Experiment Station, at State College, Pa.

JOHN HAMILTON was born at Fermanagh Farm, in Juniata county, Pa., in 1843; received his preparatory education in the public schools, and at Tuscarora and Airy View Academies. Entered the army in 1861 and served for three years. Entered the Pennsylvania State College, in February, 1865, and at the close of that year was placed in charge of the College Farm. He continued in this position until the autumn of 1868, having added to his duties the business management of the College. He re-entered College in January, 1869, and graduated in 1871, and during this period was also commandant of cadets. Upon graduating he was elected professor of agriculture in the College, having charge of the main College Farm of about 300 acres, and also of the three model and experimental farms connected with the institution. Along with his duties as professor of agriculture, he was also in charge of the business management of the College as its financial agent. In 1880 he resigned his professorship on account of ill health, but continued as business manager. He was afterwards a trustee of the College, and chairman of its executive committee, and has been treasurer of that institution since 1873; was one of the original members of the State Board of Agriculture, and in 1895 was appointed by Governor Hastings, Deputy Secretary of Agriculture and Director of Farmers' Institutes for Pennsylvania, and in 1899 was appointed Secretary of the Department of Agriculture by Governor Stone. He is the owner of two farms, which he personally oversees; is deeply interested in the subject of "good roads," and is the author of what is known as the "Hamilton Road Bill."

PROF. J. M. HANTZ was born in Westmoreland county in 1844; has had the advantages of a thorough college training, and has been a professor in different academies, colleges and universities for years. Having been reared on a farm and always feeling an interest in farm life, he has been, for the last twelve years, actively engaged in farming in an intensive way, following a three year rotation. He is interested in dairying and has made the dairy cow a special study; he has been a member of the State Board of Agriculture for four years and takes a deep interest in agriculture. Having thus had a practical knowledge of farm life since boyhood, he is prepared to talk to farmers from real scientific knowledge as well as from actual experience.

E. S. HOOVER was born in Lancaster county, Pa., in 1839, was educated in the public schools, White Hall Academy and the State Normal School at Millersville; taught school four terms, and then moved upon one of his father's farms, where he has since lived. He has been engaged in general farming, although at one time he gave special attention to the growing and feeding of live stock, and later devoted himself to the horticultural branch of agriculture.

GEORGE E. HULL, of Orangeville, Ohio, the subject of this sketch, a number of years ago moved upon a worn-out farm without buildings in Mercer county. By industry, perseverance and intelligent effort he has succeeded in restoring it to the highest state of fertility; has placed thereon substantial and convenient farm buildings, and educated his children, without other income than that derived from the farm; his silos, stock scales, farm implements and improved live stock are the admiration of all progressive farmers.

GEORGE G. HUTCHISON was born in 1854 in Huntingdon county, Pa.; was raised on a farm, working on the same in the summer and attending district school in the winter; attended Millersville Normal School one year and the Pennsylvania State College one year. At the age of nineteen he returned home and engaged in farming; has been operating a farm and raising stock up to this time. He has been a member of the State Board of Agriculture for seven years and chairman of the Farmers' Institute Committee of Huntingdon county for twelve years. He is now connected with the Dairy and Food Commissioner's office and at the same time manages his farm.

WILLIAM A. HUTCHISON was born April 20, 1875, at Warrior's Mark, Pa.; worked on his father's farm during vacations and attended schools of his native town during winters, until September, 1893, when he entered the senior year of the preparatory department at Pennsylvania State College; graduating from that, he entered Pennsylvania State College, with the class of '98, graduating with the same in the Agricultural Course, June 14, 1898. During the summer of '97 he worked in the laboratory of the Pennsylvania Experiment Station, and by competitive examination, after graduation, was awarded the Experiment Station Fellowship in Agricultural Chemistry, which he held for one year. On April 1, 1900, he became superintendent of the Chas. L. Bailey estate in Ingleside Farms and Thorndale dairy, located at Thorndale, Chester county, Pa., and subsequently became manager of a dairy farm at Manor Station, Pa. He is now connected with the Dairy and Food Division.

A. J. KAHLER was born in Hughesville, Pa., in 1834; was educated in the public schools and afterwards taught school in his native county; has always lived upon a farm; has filled every local office in his township; was a member of the Legislature in 1891-1892; was president for six years of the County Agricultural Society; is a member of the State Board of Agriculture and has been identified with most of the leading farm organizations of the State.

JOHN H. LANDIS spent the greater portion of the first forty years of his life on a farm in Lancaster county; served six years as a member of the Pennsylvania House of Representatives and four years as a member of the Senate, and has been coiner of United States mint at Philadelphia during the last five years.

J. H. LEDY was born in Marion, Franklin county, Pa., August 3, 1864, and received his education in the common schools of Guildford township and at the Chambersburg Academy. After leaving school he engaged in the mercantile business for seven years at Marion and Wayensboro, Pa. In the spring of 1889 he accepted a position with S. Smucker & Co., wholesale grocers of Philadelphia. He remained with this firm four years, when he was elected register and recorder of Franklin county, after which he became half owner and business manager of the People's Register, of Chambersburg, an independent journal of large circulation. He now owns and superintends 151 acres of apple trees, inlaid with peaches and plums. Mr. Ledy is a practical fruit grower, who loves the work and has turned his whole attention to it.

L. W. LIGHTY was born in York county, Pa., in 1857; attended the public schools of his neighborhood; afterwards attended a select school in Adams county and then taught school for seven winters. During this time he attended the York County Academy one term and also attended the State

Normal School at Millersville. He then kept store, but not liking the business, he got out of it, and started in the poultry business, keeping both market and fancy poultry, and engaged in bee-keeping and the culture of small fruits. In 1893 he purchased the farm upon which he now lives. The land was worn out and the buildings quite dilapidated. He has improved this until it is now one of the best farms in his county. He has a large library of standard books, keeps a selected dairy of cows, and has all the modern improvements needed to equip a first class farm.

M. S. McDOWELL was born in Mifflin county, Pa.; attended the public schools, and Lewistown Academy; entered Pennsylvania State College in 1888, and was graduated in '92; after graduation was connected with a fertilizer manufacturing establishment in Baltimore, and later came to the chemical department of the Experiment Station, with which he has been connected four years.

BENJAMIN F. MacCARTNEY was born at Altoona, Pa., December 15, 1871; was educated in the Altoona public schools and afterwards attended the South Jersey Institute, at Bridgeton, N. J., the Indiana State Normal and Princeton College. He actively engaged in the real estate business at Altoona, Pa., and afterwards in the iron industry at Indiana, Pa., subsequently moving to Hamilton, Jefferson county, where he at present resides. Was appointed postmaster at the latter place by President McKinley on June 15, 1899. At the sessions of the Legislature in 1899 was named as executive clerk of the Senate, and on September 1, 1899, was honored with the appointment of State Zoologist. He has always been an active stalwart Republican and a strong believer in its principles. His family consists of his wife, formerly Mabel C. Mitchell, only daughter of Senator J. G. Mitchell, and one child, a son.

A. L. MARTIN, by occupation a farmer, was born near Mount Jackson, Lawrence county, Pa., in 1844; received his education in the public schools and at Poland (Ohio) College; served as school director in his native township and that of Little Beaver for eight years; filled the position of census enumerator in 1890; was elected to the House of Representatives in 1892, and served continuously until 1899; was during this continued service a member of the Agricultural Committee, and acted as its chairman in the session of 1897; by appointment of Governor Pattison, in 1893, became member of Farmers' National Congress, was reappointed in 1895 by Governor Hastings to same position, in which year he served as Pennsylvania's vice president, and is by appointment of Governor Stone a member of present Congress which convenes at Macon, Ga. Was appointed by Governor Stone April 24, 1899, Deputy Secretary of Agriculture and Director of Farmers' Institutes for Pennsylvania.

JOHN T. McDONALD was born in 1842, near Delhi, N. Y., and lives upon a farm of about 200 acres, 160 of which is improved. He was educated in the public schools; began farming in 1875, went heavily into debt for his farm, and paid for it in twelve years, at the same time improving the buildings and land. He produces from 20,000 to 25,000 pounds of butter annually ,which he sells for 35 cents per pound. He turned out last year about $10,000 worth of produce. He keeps ninety cows, and they average a little over 300 pounds of butter each. He sold, during the years, over $2,000 worth of chickens, eggs and turkeys.

M. E. McDONNELL was born at Florence, Washington county, Pa., in 1873. He graduated at the Pennsylvania State College in 1893, and received the degree of Master of Science in 1896. Since September, of 1893, he has been a member of the State College Experiment Station force, where he has made a specialty of chemistry and bacteriology of dairy products. In 1896 he did some work in bacteria of the dairy under the instruction of Dr. Conn, of the Storrs Agricultural Experiment Station. In 1897 he made an extensive examination into the actual condition of the milk supplies in the various cities of Pennsylvania. He has also been giving instruction in the creamery and dairy courses to the students at State College.

PROF. FRANKLIN MENGES, Ph. D., was born forty-three years ago at Menges' Mill, York county, Pa.; the first nineteen years of his life were spent on his father's farm, with all the ardour that farming meant in those days; he then began a course of preparation for college at the Baugher Academy, Hanover, Pa., and entered and graduated from Pennsylvania College, Gettysburg, with the class of 1886; was immediately tendered and accepted the position of assistant professor of chemistry in his alma mater, which position he held until 1896, when he came to York and took the professorship of the sciences in the York high school, which position he now holds; received the degree of Ph. D. from his alma mater for special work in chemistry, mineralogy and physics. He has for years been a student of the "Experiment Station Record," and has continued an interest in practical agriculture, and has lectured before Farmers' Institutes.

C. D. NORTHROP was born in Brookfield, Tioga county, Pa., in 1854; was educated in the public schools and at Woodhall (N. Y.) Academy. In 1891, he attended a dairy school at Geneva, N. Y., under the auspices of the New York Dairymen's Association. For the past twenty years he has made a specialty of dairying and the making of fine butter. He has been a teacher in the public schools, and has devoted a good deal of time to lecturing before alliances, granges, farm clubs, etc.

HENRY W. NORTHUP was born on a farm in Abington, once considered the banner agricultural township in Luzerne county; he was educated in the public schools and at Madison Academy; his chief business is that of farmer and dairyman; has been greatly benefitted in this line of business for the last ten years by having associated with some of the best and most practical agriculturalists in this and adjoining States in the institute work; has had some experience in fruit and market gardening and the disposition of these products in the city of Scranton, where an excellent market has been secured.

T. E. ORR was born in Brooke county, Va., September 28, 1853. When nineteen years of age he was on the stock farms of his father and grandfather and attending country schools. From 1872 to 1876 he taught country school two winters and attended National Normal School balance of that time, graduating in 1875. Taught surveying and civil engineering in 1876-7. From 1877 to 1886 was superintendent or principal of public schools as follows: Mt. Vernon, Ind.; Le Mars, Ia.; Wellsburg, W. Va. and Bridgeport, O., doing Teachers' Institute work each summer. Leaving Bridgeport in 1886, and a salary of $1,800 per year, he took an interest in the "National Stockman and Farmer," being one of its publishers and editors, which position he occupied until 1901, doing occasional Farmers' Institute work and acting as expert judge on poultry and live stock. Mr. Orr has always been closely identified with live stock and poultry associations.

J. Y. PATTON was born forty-one years ago, and has been engaged in agriculture all his life; has conducted a dairy for the past thirteen years, and engaged in the poultry business for seven years.

JOSEPH H. PASCHALL was born in 1856 on the old homestead farm in Delaware county, Pa., upon which he has resided all his life. He obtained education in the public schools, and at Maplewood Institute and took the four-years' Chautauqua literary and scientific course. He is a practical farmer, and his experience has been along the lines of butter-making, chickens and fruit, retailing in market nearly all that he produces. For many years he has sold more butter and eggs in the Farmers' market, at Chester, than any other farmer.

J. H. PEACHY was born in Mifflin county, Pa., in 1851. His boyhood was spent upon a farm; was educated in the public schools, and graduated from the Ohio Normal University in 1881. After completing his course at school he followed teaching. In 1887 he began farming for himself and gave attention chiefly to raising hogs, sheep and cattle.

LEONARD PEARSON, State Veterinarian, was born in Indiana, August 17, 1868. In 1884 he entered Cornell University, and graduated in 1888 in the agricultural course. He graduated from the Veterinary Department of the University of Pennsylvania in 1890. During 1890-91 he attended lectures in the veterinary schools of Berlin and Dresden. In 1892 Dr. Pearson was appointed non-resident lecturer on veterinary science at the Pennsylvania State College. He was appointed State Veterinarian in 1896, which position he now holds by reappointment of Governor Stone, and immediately thereafter was elected secretary of the State Live Stock Sanitary Board.

THOMAS J. PHILIPS was born upon a farm in Chester county, Pa., December, 1846; attended public and private schools and graduated from Bucknell University in 1867; spent three years in manufacturing iron and traveling, and then settled upon the farm where he still lives, giving special attention to dairying and raising dairy stock, but devoting much of the 200-acre farm to the production of mixed crops, suitable to that location and market. That he has been a success is attested by the fact that he has been a director in a national bank for many years, a manager in one of the largest fire insurance companies in the State, and of a building and loan association; served two terms in the State Legislature, as a representative of the farming interests; he has contributed acceptably from time to time of his experience to the agricultural press, and in every way has kept in the front amongst the most progressive of his locality, believing in higher education, attractive country homes and that success is the result of individual effort and judgment.

W. H. H. RIDDLE was born at Carnegie, Allegheny county, Pa., December 11, 1840; lived and worked on his father's farm until about 18 years of age; attended Sunbury Academy, where he received an academic course; after teaching school seven years, read law and practiced thirty years. During twenty-five years the subject of this sketch owned and managed a farm; he also helped organize an agricultural and fair association, and has taken an active part in its management for the past twenty-two years, being its president for ten years; has been a member of the State Board of Agriculture since 1886, and Local Manager of Institutes for Butler county. A love of agricultural pursuits led him to abandon his law office and devote his entire time to the management of his farm of some 200 acres, upon which special attention is given to the propagation of plants under glass, etc.

OLIVER D. SCHOCK was born on a farm near Hamburg, Berks county, Pa., in 1858, and has always taken a deep interest in agricultural and horticultural affairs. He was educated in the common and high schools, including a course in a commercial and scientific academy. At the age of fifteen he became a newspaper correspondent, and continues to represent leading daily papers and agricultural journals. For a number of years he served as a special agent of the Pennsylvania State Board of Agriculture, and later as a clerk in the office of the Board, assisting Secretary Edge. With the creation of the Department of Agriculture, in 1895, Governor Hastings promoted Mr. Schock to the position of Chief Clerk of that Department, which position he filled until July, 1899.

R. F. SCHWARZ was born near Berlin, Germany, in 1853; educated in Ducal Gymnasi and Ducal College, at Dessau. He came to New York in 1871, removed to Chicago in 1873, and in 1875 bought a farm in Monroe county, in this State, where he has since followed the business of fruit growing and market gardening, devoting at the present time about thirty acres to this pursuit. He was a member of the House of Representatives two terms, 1893 and 1895.

R. S. SEEDS was born in Huntingdon county, Pa., in 1852; was educated in the public schools and at the Shade Gap Academy. He was raised upon a farm and traveled for eighteen years among the farmers, selling agricultural implements. In 1892 he bought a farm that had been run down, which he has now greatly improved.

JASON SEXTON was born in Schoharie county, N. Y., in 1834, and was educated in the public schools of his township. Worked upon his father's farm, who always kept a dairy of from twenty-five to thirty-five cows, making both butter and cheese; enlisted in the Union army in 1862, and served throughout the war; upon retiring from the army be bought his father's farm of 200 acres, going in debt for two-thirds of the purchase money, and paying 7 per cent. interest. He continued the dairy, but in 1874 sold the farm, and in 1876 moved to Montgomery county, Pa., where he now resides. He there became manager of William M. Singerley's farms, comprising 825 acres of land. He had charge of the breeding of several hundred registered Holsteins and Jerseys, South sheep and Berkshire pigs, also feeding as many as 125 steers and from 800 to 1,000 sheep, besides milking a large dairy of from 50 to 100 cows.

W. H. STOUT was born October 18, 1840, in Lower Nazareth township, Northampton county, Pa.; was educated in the common schools and engaged in various occupations, serving an apprenticeship at coopering and milling, at clerkship and traveling salesman; has lived on his present farm for the past twenty-seven years, and is engaged in general farming, trucking, fruit growing and bee-keeping; has acquired practical and scientific information by observation and study; speaks English and German.

DR. I. A. THAYER was born near Warren, O., in November, 1840. He was reared on a farm of which he was foreman for a number of years under a scientific and successful farmer; was educated in Hiram College, under the presidency of Gen. Garfield. He graduated in medicine in 1866, and practiced that profession several years. Since laying down that practice he has been engaged in public speaking, having during fifteen years filled important lecture engagements from Boston to St. Louis, under the management of the leading lyceum bureaus. He has recently finished the course in crop production and that in live stock production in our State College. For nine months in the year his time is given wholly to his farming operations, for years conducting a veritable experiment station where he has worked with a book in one hand and a hoe in the other; hence, he is equipped with a practical knowledge that he has the ability to express in the clearest manner.

O. W. STOUGHTON was born in Butler county, Pa., in 1853; was educated in the common schools and at Witherspoon Institute; has had some experience in the mercantile business, but has been farming almost all his life. He is a successful dairyman, carrying it on after the latest scientific methods, both as to the care and feed of cows and the management of the product. He is also in charge of a large creamery which has been very successful.

HARVEY ADAM SURFACE, M. S., Professor of Zoology in the Pennsylvania State College, was born on a farm in Warren county, O., in 1867. He worked on the farm and attended and taught country school. He was educated in the Lebanon (O.) Normal, the Ohio State University, the University of Illinois, Hopkins (Stanford) California Seaside Laboratory and Cornell University. He taught in the Ohio State University, the University of the Pacific, Cornell, the Ithaca schools, teachers' institutes and the Pennsylvania State College. He held a fellowship in Cornell and was also appointed Dykman Research Fellow in Columbia University. He was field naturalist for the Illinois State Biological Station and University Extension lecturer in New York. He has also been lecturer in zoology at the West Coast Chautauqua Assembly and scientific assistant on the United States Fish Commission. He has taught in every known grade of school work, and is noted for his enthusiasm and ability as a teacher, speaker and writer. He is ornithologist of the Pennsylvania State Board of Agriculture, and is making investigations of insects for the Pennsylvania State Department of Agriculture and of fishes for the Pennsylvania State Fish Commission. Among his writings are articles on nature study, zoology, mollusks, insects, fishes, birds, mammals, pedagogy, anatomy, etc. He is nature study editor of the "Popular Educator," ornithological editor of "American Gardening," member of the American Society of Naturalists, American Association for the Advancement of Science, the American Ornithologists' Union, the Pennsylvania State Audubon Society, etc. He makes a specialty of the biologic and economic features of his subjects.

O. J. VINE was born in Stark county, O., in 1856; was educated in the public schools of that district, and later in life took a couse in dairying and butter-making at the Ohio University. He is a dairyman, making this a specialty, and has been engaged as a lecturer before farmers' institutes for the past six years.

SAMUEL W. H. WALTZ was born in Anthony township, Lycoming county, Pa., January 8, 1869. He was educated in the public schools, Muncy high school, Lycoming County Normal School and Williamsport Dickinson Seminary. He taught in the public schools for several terms, and was afterwards elected a member of the school board of his native township. His home has always been on the farm, and he grew to manhood among scenes and circumstances that thoroughly imbued him with an intense love for nature and the intrinsic value of self-reliance. Mr. Waltz is essentially a self-made man, experience being his best teacher. He begun to study agricultural science in boyhood and ever since has strenuously endeavored to follow those principles taught him by experience. He regards experience his safest teacher, but is always ready to entertain, with due consideration, what others may have acquired and ever anxious to profit by their diligence and research, which stand him in good stead to acquire those elements of knowledge that go to make up a progressive and up-to-date agriculturist. He is particularly fond of horticulture, botany, ornithology, apiculture, geology and astronomy, all of which bring him in close touch with every-day life on the farm.

R. L. WATTS was born at Kerrmoor, Pa., June 5, 1869; raised on the farm of his father, Martin Watts, which farm was largely devoted to fruit culture. Entered Pennsylvania State College in 1887; graduated from agricultural course in June, 1890. He was elected Assistant Instructor in Botany and Horticulture of the University of Tennessee and Horticulturist of the Agricultural Experiment Station of this institution in September, 1890. Later he was made Instructor of Horticulture, followed by Assistant Professor of Horticulture and Secretary of the Experiment Station. Besides the regular duties as secretary, he had charge of the farmers' institutes of the State, held under the auspices of the University and Station; he prepared programmes, conducted correspondence and participated in the meetings. While at the station he conducted various experiments with fruits and vegetables in the greenhouse and out of doors, the results of which have been published in bulletin form. He wrote Farmers' Bulletin No. 39 on "Onions," for the U. S. Department of Agriculture. For several years he was editor of the fruit and vegetable department of the "Southern Florist and Gardener;" he is now engaged in gardening and fruit culture with a poultry plant to accommodate 500 hens.

F. J. WAGNER was born on a farm near Claridge, Pa., in 1868; received a good common school education, with a course at a business college. Taught public school two terms, besides which has been steadily pursuing diversified farming; is much interested in the State College Correspondence Course in Agriculture.

JOHN A. WOODWARD was born in Lycoming county, in 1841, and was educated in select schools and at Dickinson Seminary. He learned the printing business, and at the age of nineteen was local editor and foreman of the printing office of a weekly paper in Lock Haven, and at twenty was editor and half-owner of the "West Branch Bulletin." Afterwards he was railroad conductor, and later on, up to 1871, engaged in manufacturing at Williamsport. In 1871 he moved to Howard, Pa., upon a farm, where he has remained ever since. For sixteen years he was engaged in agricultural editorial work, served two terms in the Pennsylvania Legislature, is a trustee of the Pennsylvania State College, is a member of the State Board of Agriculture and was deputy executive commissioner of the World's Fair Commission for Pennsylvania. He has, for a number of years, lectured on agriculture in several of the eastern States, and has for the past four years had charge of one of the farmers' institute sections in Pennsylvania.

SAMPLE PROGRAMME—This Sample is Designed as an Aid to Institute Managers in Making up Their Programmes.

Programme

OF THE

....................County

Farmers' Institute

TO BE HELD UNDER THE AUSPICES OF

Department of Agriculture

of Pennsylvania.

In..........................Hall,

....................Pa.

On Friday and Saturday,

December 5 and 6, 1902.

Exercises Public and Free.
Everybody is Invited. = = =

ORDER OF BUSINESS.

Opening Session,

Devoted to Soil Conditions.

Wednesday Afternoon, December 3, 1.30.

Presiding officer, ...

1.30. Opening Exercises.

2.00. Soil Fertility,

by......................

Discussion opened by......................

3.00. Soil Cultivation,

by......................

Discussion opened by......................

4.00. How to Conserve Soil Moisture,

by......................

Discussion opened by......................

(Question Box.)

5.00. Adjournment.

Educational Session.

Wednesday Evening, December 3, 7.00.

7.15. Nature Study for Country Schools,

by......................

Discussion opened by......................

7.45. Essential Qualifications to Successful Teaching,

by......................

Discussion opened by......................

8.30. Attractive Country School Grounds,

by......................

Discussion opened by......................

9.15. The Central Township School,

by......................

Discussion opened by......................

10.00. Adjournment.

Dairy, Stock and Poultry Session.

Thursday Morning, December 4, 9.00.

(Question Box.)

9.30. Feed for the Dairy Cow,

by......................

Discussion opened by......................

10.30. Beef Types,

by......................

Discussion opened by......................

11.15. Poultry Breeding and Feeding for Profit,

by......................

Discussion opened by......................

12.00. Adjournment.

Thursday Afternoon, December 4, 1.30.

(Question Box.)

2.00. Good Country Roads; How Obtained,

by......................

2.45. Sheep Husbandry,

by......................

3.30. Legumes for Feed and Fertility,

by......................

4.00. The Silo as an Economic Investment in the Dairy,

by......................

4.30. Adjournment.

Ladies' Session.

In the Interest of Country Homes.

Thursday Evening, December 4, 7.00.

7.00. Music.

7.15. A Model Home.

by......................

7.45. What Books and Magazines Shall We Read; The Quality and Preparation of Food.

by......................

8.15. Heating, Lighting, Ventilating and Sanitary Arrangement of Country Homes,

by......................

9.00. Lawn and Garden,

by......................

9.30. Social Life in Rural Districts,

by......................

10.00. Adjournment.

SPECIAL NOTICE.

The foregoing order will be followed as closely as possible, but other exercises will be introduced, if found desirable.

Speeches, essays and papers ought not to exceed twenty minutes. The papers, when read, are considered the property of the Department of Agriculture.

Although these institutes are designed and conducted for the education and advantage of farmers, yet all who are interested are invited to attend, and it is hoped that they will show their appreciation, not only by being present at the meetings, but also by taking part in the discussions.

Ask Questions.

A question box will be kept upon the secretary's desk, and all are invited to place therein such questions as they may wish to have discussed during the session. At the proper time, designated by the meeting, these questions will be referred to some one for answer, or brought up for general discussion.

All granges, alliances, agricultural societies and kindred agricultural organizations are specially invited to attend.

For further information, and for programmes, address,

Name, ...

Address, ...

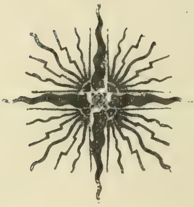
Chairman of the Board of Institute Managers for ——— County.

Local Committee.	Committee on Question.	County Board of Managers.
Wm Stevens, Address, ...	William Stover, Address, ...	J. A. Walker, Address, ...
Mrs. Jane Weily, Address, ...	Miss Jane Miller, Address, ...	Wm. Cedars, Address, ...
Miss Emma Stone, Address, ...		John Williams, Address, ...

Means of Access.

Trains on the B. C. R. R. arrive from the east at 8.30 a. m. and 5.19 p. m.; from the west at 9.40 a. m. and 9.38 p. m.

On the P. R. R. trains from the east arrive at 4.52 and 9.54 a. m. and 4.32 p. m.; from the west at 10.18 a. m. and 5.08 and 9.23 p. m.



COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN NO. 104.

Modern Dairy Science and Practice,

BY

LUCIUS L. VAN SLYKE, PH. D.

Chemist, New York Agricultural Experiment Station, Geneva, N. Y.

PUBLISHED BY DIRECTION OF THE SECRETARY.

1902.

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1903.

VIRTUE
LIBERTY AND
INDEPENDENCE

PREFACE.

Harrisburg, Pa., September 3, 1902.

The following Bulletin, No. 104, upon "Modern Dairy Science and Practice," by Lucius L. Van Slyke, Ph. D., Chemist of the New York Agricultural Experiment Station, is issued by this Department for the purpose of aiding our dairymen in their efforts to understand the scientific facts that underlie dairy production. Dr. Van Slyke is an acknowledged authority upon dairy science and practice; his statements and recommendations, therefore, can be relied upon as being the latest and best information upon this subject.

JOHN HAMILTON,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

Hon. John Hamilton, *Secretary of Agriculture, Harrisburg, Pa.*

Dear Sir: I have the honor to transmit herewith a bulletin, entitled "Modern Dairy Science and Practice," which has been prepared in compliance with your request and in accordance with suggestions approved by you.

Respectfully yours,
LUCIUS L. VAN SLYKE, Ph. D.,
Chemist, New York Agricultural Experiment Station.

Geneva, N. Y., Sept. 3, 1902.

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MODERN DAIRY SCIENCE AND PRACTICE.

By L. L. Van Slyke, Ph.D., Geneva, N. Y.

INTRODUCTION.

Dairying has for its objects the production of milk and the manufacture of various food products from milk. Dairying may, therefore, be divided into two fairly distinct departments: Dairying (1) as a branch of agriculture, and (2) as a manufacturing industry.

Considered as the source of milk production, dairying is a branch of agriculture; for the producer of milk tills the soil, raises food crops for the cattle, rears dairy animals, and obtains milk as his finished product. He is a manufacturer, employing agricultural methods. Considered as a source of cream, butter, cheese, etc., dairying is a manufacturing industry. The maker of butter and cheese starts with milk as his raw material and employs methods that are essentially industrial and in no way connected with agriculture proper. While these two departments of dairying have in the past been carried on largely side by side on the farm, the modern tendency has been toward a more complete separation. Attention is here called to these two divisions of dairying, because it is the writer's purpose in this treatise to dwell almost entirely upon the second division. To attempt to cover the field of dairying in its broadest sense would practically involve consideration of a large portion of the broad domain of agriculture.

Dairying is both an art and a science, whether considered in its restricted or broad sense.

The art or practice of dairying embraces certain practices and processes which have been gradually developed by experience and observation. The art of dairying, in its widest application, teaches how to cultivate the soil for the production of certain crops; how to make and use fertilizers; how to breed, feed and care for dairy animals for the production of milk; how to produce cream, butter, cheese, etc., from milk.

The science of dairying embraces a collection of the general principles or leading truths, arranged in systematic order, relating to the operations of dairying. Thus, among other things, the science of dairying explains the growth of animals, the relation of foods to milk production, the chemical composition and physical properties of milk and its products. It consists of an application of the truths of such sciences as physiology, chemistry, physics, botany, etc., to the practical operations of dairying.

Dairying has undergone many profound changes during the last generation, and more particularly during the last fifteen years. This is true of both the agricultural and the manufacturing phases of dairying. We can fully realize this by noticing the changes in its very language. Even ten years ago few dairymen would have been able to use intelligently, if at all, many of the expressions that are very common now, such as bacteria, lactic acid fermentation, pasteurization, sterilization, separator cream, ripened cream, fat basis for paying dividends, ripening tests, etc., etc. With all the advance in knowledge and the improvement in practice that we have witnessed in recent times, there are still many unsolved problems in dairying; but we do well to be impressed with the great things which have already been accomplished and to appreciate the advantageous position we are now in for making further progress, compared with the position we were in only fifteen years ago.

These changes for the better have been brought about through the combination of a variety of educational agencies, among which may be mentioned our agricultural experiment stations, dairy schools, State Departments of Agriculture, farmers' institutes, the agricultural press, farmers' clubs, etc.

Our dairy products, as a result of improved methods of producing milk and of improvement in manufacturing processes, are greatly superior on the average to those we made half a generation ago. The consuming public has, to some extent, become more choice in its tastes and exacting in its demands; in other words, the present standards required for dairy products are higher than they were.

The object of this little treatise is to present, with a moderate degree of fullness, some of the results of these recent years of progress, so as to give the reader some idea of what constitutes "Modern Dairy Science and Practice."

CHAPTER I.

THE CHEMISTRY OF MILK.

1. General Composition of Milk.

In milk, as well as in most of its commercial products, we find the following compounds and classes of compounds:

(1) Water.
(2) Fat.
(3) Nitrogen compounds or proteids.
(4) Sugar.
(5) Salts or ash
(6) Gases.

In giving the description of any individual chemical compound in connection with the chemistry of milk, we shall not need to repeat the description when we come to consider that compound in connection with the products of milk; for, it will be found, the description given here will apply to the same compound wherever we find it. The word milk, as we shall use it, refers always to cows' milk, unless otherwise stated.

2. Water.

1. Chemistry.—The water present in milk and its products, however much its presence may be disguised, is one and the same compound of hydrogen and oxygen, with which we are everywhere familiar. The water in milk and its products is simply plain, common water, possessing no chemical peculiarities to distinguish it from water found anywhere else. It is only ordinary water in the company of other chemical individuals.

(2.) Purpose.—The water in milk serves the purpose of holding in solution the soluble constituents of the milk. It also acts as a diluent, better fitting the mixture as animal nutriment.

(3.) Amount of Water in Milk.—The amount of water contained in milk varies considerably, depending upon a variety of conditions, such as individuality, breed, stage of lactation, age, character of food, amount of water drunk, condition of health, etc.

(a.) Single Milkings.—Taking single milkings of individual cows, we may find the amount of water in 100 pounds of milk varying from 82 to 90 pounds or more, corresponding to 10 to 18 pounds of total solids.

(b.) Lactation Period of Single Cows.—In case of milk from single cows for an entire period of lactation, the variation of water may range from 84 to 89 pounds, corresponding to 11 to 16 pounds of total solids.

(c.) Herds.—Taking milk from herds of cows, the variations of water are within narrower limits, usually ranging from 86 to 88 pounds in 100 pounds of milk, corresponding to 12 to 14 pounds of total solids.

In the case of average milk, as found in the United States, 100 pounds of milk contain from 87 to 87 1-4 pounds of water, corresponding to 12 3-4 to 13 pounds of solids.

(d.) Breed.—As regards the influence of breed of cow upon the proportion of water in milk, the following figures, taken from the Geneva (N. Y.) Station records, serve as a fair illustration:

Name of Breed.	Lbs. of water in 100 lbs. of milk.	Lbs. of total solids in 100 lbs. of milk.
Holstein,	88.20	11.80
American-Holderness,	87.35	12.65
Ayrshire,	87.25	12.75
Shorthorn,	85.70	14.30
Devon,	85.50	14.50
Guernsey,	85.10	14.90
Jersey,	84.60	15.40

(e.) Advance of Lactation Period.—The following figures, showing the variation of water in milk with advance of lactation of period, are based upon averages derived from an aggregate of nearly fifty lactation periods of individual cows, covering the first ten months of lactation:

Month of Lactation.	Lbs. of water in 100 lbs. of milk.	Lbs. of total solids in 100 lbs. of milk.
1,	86.00	14.00
2,	86.50	13.50
3,	86.53	13.47
4,	86.36	13.64
5,	86.25	13.75
6,	86.00	14.00
7,	85.82	14.18
8,	85.67	14.33
9,	85.54	14.46
10,	85.17	14.83

We notice a general tendency for the water to increase for three months, after whcih there is a constant decrease to the end of the lactation period. A similar tendency is shown in the illustration given below, which covers a large number of samples of milk obtained from cheese factories, representing practically the first six months of the lactation period.

Month.	Lbs. of water in 100 lbs. of milk.	Lbs. of total solids in 100 lbs. of milk.
May,	87.44	12.56
June,	87.31	12.69
July,	87.52	12.48
August,	87.37	12.63
September,	87.00	13.00
October,	86.55	13.45

(f.) Age. There are not available many data giving reliable information in respect to the influence of the age of a cow upon the amount of water in milk. There is more or less variation in different individuals. From the limited amount of data accessible, there appears to be a general tendency for cows to produce milk with least water during the second period of lactation, after which the amount of water in the milk increases with the age of the animal.

3. Milk-Fat (or Butter-Fat).

1. Milk-Fat a Mixture.—Milk-fat is not a single, invariable compound, but is a somewhat variable mixture of several different compounds, each of which contains the elements carbon, hydrogen and oxygen, combined in different proportions. Each of these separate compounds, contained in milk-fat, is formd by the chemical union of glycerin with some acid of a particular kind. These glycerin-acid compounds contain about ten different acids, but some of them are present in very small quantities; in fact, 90 per cent. of milk-fat is made up of only four of these compounds. We can, in a general way, represent the composition of these four most important glycerin-acid compounds of milk-fat in the following manner:

Glycerin and palmitic acid form palmitin.
Glycerin and oleic acid form olein.
Glycerin and myristic acid form myristin.
Glycerin and butyric acid form butyrin.

These four compounds are present in milk-fat (or butter-fat) in something like the following amounts:

Palmitin, 40.5 per cent.
Olein, 34.0 per cent.
Myristin, 10.5 per cent.
Butyrin, 6.2 per cent.

The proportions of these constituents of milk-fat vary somewhat and this variation influences the character of the milk-fat.

(2.) Melting Points of Constituents of Milk-Fat.—In order to understand more fully some of the properties of milk-fat, we will briefly notice some of the more important properties of the above-mentioned compounds.

Palmitin has a rather high melting point, 144 degrees F.

Myristin melts at 129 degrees F.

Olein and butyrin are liquid at ordinary temperatures. Olein has the important property of being able to dissolve and hold in solution the less easily melting palmitin and myristin, above certain temperatures.

Palmitin and myristin tend to produce hardness in butter; olein and butyrin, softness.

(3.) Glycerin is present, chemically combined with acids, in all fats. It forms, on an average, about 12.5 per cent. of pure milk-fat or butter-fat.

(4.) Physical Properties of Milk-Fat.—Milk-fat, in pure, fresh condition, appears at ordinary temperatures as a soft, white to yellowish mass, with mild taste and very slight odor. It easily takes on a granular structure. It melts easily and is lighter than water.

Our knowledge of the color of milk-fat is very limited. Whether the color is a property of some one of the compounds of milk-fat, or whether it belongs to some special substance, mechanically held by the milk-fat, we can not say positively, but the latter supposition is probably nearer the truth. It is well established that the color of milk-fat varies with individual cases, with breeds, with advance of lactation and with the food.

(5.) Milk-Fat in Form of Globules.—Milk-fat is present in milk in the form of very small, transparent globules, too small to be seen by the unaided eye. The sizes most commonly met with are between 1-2500 and 1-15000 of an inch in diameter, and the average diameter is not far from 1-10000 of an inch. Some globules are as large as 1-1500 of an inch and some as small as 1-40000 of an inch. The smaller fat-globules are more numerous than the larger ones. In one drop of average milk there are about 150,000,000 fat globules.

Formerly it was very generally believed, and is still held by some, that fat-globules of milk are surrounded by a membranous covering. In some respects, fat globules behave as if they were enclosed in a membrane. The theory also has been advanced that the fat-globules are surrounded by a semi-solid membrane of slime. Without going into details to state the reasons, we may accept it as established beyond reasonable doubt that fat-globules have no special covering, but are simply minute particles of fat floating free in milk in the form of an emulsion. There is no difference in the composition of the fat in the large and small globules.

(6.) Amount of Fat in Milk.—The amount of fat present in normal milk varies greatly, going, in the case of single milkings of individual cows, below 2 per cent. and above 10 per cent. The average of fat in the milk of herds of cows varies commonly between the limits of 3 and 5 per cent. The average amount of milk-fat in milk produced in the United States, taking the true average for an entire year, lies between 3.75 and 4 per cent., and somewhat nearer the latter figure.

Many of the conditions that affect the amount of fat in milk have been studied and are well established, while others are but little understood. We will consider briefly some of the better-known conditions.

(a.) Individuality.—It is uncommon to find in a herd of cows any two individuals whose milk contains the same per cent. of fat, whether we consider individual milkings or the average of many milkings. This is simply one of many factors that go to make a cow's individuality.

(b.) Breed.—It is well known that the per cent. of fat in milk varies in a more or less characteristic way with the kind of breed. While there is marked variation in indivduals of the same breed, there is found to be a fairly uniform difference, more or less marked, if we take the average of several individuals. It is largely owing to this influence that we find the milk of one country differing from that of another, or the milk of one section of a country differing from that of another section. For example, the average per cent. of fat in milk in Germany and Holland is fully one-half per cent. lower than in this country, because the prevailing breeds of cows there are the ones producing milk comparatively low in fat. The figures given in the following table are taken from the records of the Geneva (N. Y.) Station and represent averages of several individuals covering several periods of lactation:

Name of Breed.	Per Cent. of Fat in Milk.		
	Average.	Lowest.	Highest.
Holstein,	3.36	2.88	3.85
Ayrshire,	3.60	3.20	4.24
American-Holderness,	3.73	3.49	3.92
Short-Horn,	4.44	4.28	4.56
Devon,	4.60	4.30	5.23
Guernsey,	5.30	4.51	6.13
Jersey,	5.60	4.96	6.09

(c.) Age.—So far as published data throw light upon the question of the influence of age upon the amount of fat in milk, the more common tendency appears to be for milk to become less rich in fat with each succeeding period of lactation, especially after the second, though individual exceptions to this tendency are not infrequent. We need more extended data bearing upon this point before we can speak with any degree of positiveness.

(d.) Advance of Lactation Period.—In general, it is found that the per cent. of fat in milk increases as the stage of lactation advances. The following figures represent the averages obtained from an aggregate of nearly fifty lactation periods of different cows, covering a period of ten months:

Number of Month of Lactation.	Per cent. of fat in milk.
First,	4.54
Second,	4.33
Third,	4.28
Fourth,	4.39
Fifth,	4.38
Sixth,	4.53
Seventh,	4.56
Eighth,	4.66
Ninth,	4.79
Tenth,	5.00

(e.) Variation of Time Between Milkings.—As a rule, the longer the time between two successive milkings, the smaller is the per cent. of fat in the milk, and the shorter the time between milkings, the greater the per cent. of fat. When the time between milkings is uniformly equal, the variation of fat in milk is small, provided the general conditions surrounding the cow are the same. However, as there is not commonly such entirely uniform condition of surroundings during the day and night, there is probably a common tendency in the direction of a little more fat in the morning's milk.

(f.) Relation of Yield of Milk to Fat.—Large yields of milk are usually, though not necessarily, accompanied by lower percentages of milk-fat, while smaller yields are more commonly associated with larger percentages of fat.

(g.) Influence of Food Upon Amount of Fat in Milk.—This question has been the subject of investigation for years, but we are not yet able to say that we can "feed fat into milk," under ordinary, normal, practicable conditions. It has been noticed by several investigators that a very marked change in the general character of food, as from an insufficient amount of dry hay to an abundance of nutritious, succulent food, is accompanied by an increase in the percentage of fat in milk, as well as in the yield of milk.

The writer has noticed that, in the case of milk taken to cheese factories, the fat increased very noticeably and generally during the latter half of May, as compared with the preceding portion of the month. In these cases, the cows were commonly fed on timothy hay, without grain, until pasturage came. There was thus a very marked change in the character of the food. However, we cannot deny that the more favorable surroundings of the cows at pasture, as compared with the cows kept in the stable or yard, exerted an influence that should not be overlooked. Taking the milk of quite a large number of different cheese factories we found, on an average, during the first half of May, the per cent. of fat was 3.46, and during the latter half 3.70, an increase of 0.24 per cent. in a brief space of time.

(h.) Variation of Fat in Different Portions of Milk Drawn from Udder.—In the case of the figures given below, the udder was milked as nearly as possible in four equal portions.

	First cow—Per cent. of fat in milk.	Second cow—Per cent. of fat in milk.	Third cow—Per cent. of fat in milk.
First portion,	0.90	1.60	1.60
Second portion,	2.60	3.20	3.25
Third portion,	5.35	4.10	5.00
Fourth portion,	9.80	8.10	8.30

It is seen that in every case the first fourth of the milk drawn from the udder is very low in fat, and that the fat increases in successive portions drawn, until in the last it is extremely high. The most satisfactory explanation offered for this behavior of fat in milking is that the fat-globules strike against the sides of the minute ducts, through which they flow, and the friction thus caused holds the globules back, the milk that remains in the ducts becoming increasingly richer in fat in consequence.

4. The Nitrogen Compounds or Proteids of Milk.

(1.) Number of Proteids in Milk.—So far as our present knowledge goes, we appear to be justified in believingthat milk contains not more than four nitrogen compounds or proteid bodies, and these are:

Casein,
Albumin,
Globulin,
Galactase.

Globulin and galactase are present in so small quantities that we can regard casein and albumin as being essentially the nitrogen compounds of milk. These bodies are called nitrogen compounds, because they contain, in addition to other elements, the very important element called nitrogen. These nitrogen compounds of milk or milk proteids can be formed only from proteids received by the cow in the food.

(2.) Milk-Casein.—This is the most important proteid in milk, because it is the one present in largest quantity and also because its presence makes it possible to convert milk into cheese. Milk-casein is most familiar to us in the form of the white, solid substance, or curd formed in milk when it sours, though, strictly speaking, this white substance is not milk-casein but a compound formed by it with acid.

(a.) Casein in Milk Not in Solution.—For a long time it was thought that casein was in true solution in milk; but evidence, produced by different lines of investigation, show beyond question that casein exists in milk in the form of minute, solid, gelatinous particles in suspension. Casein forms a considerable part of separator slime.

(b.) Composition of Casein.—Casein is a very complex chemical compound, containing the elements of carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus. It is believed that calcium (or lime) compounds are in some way combined with casein.

(c.) Action of Acids on Casein.—Very dilute acids completely coagulate or solidify the casein of milk. In this action the acid forms a compound with casein. If a large amount of acid is added to milk, the casein is first coagulated and then dissolved, as in the case of adding sulphuric acid to milk in the Babcock test bottles. The action of acids in coagulating milk-casein is hastened by increase of temperature.

(d.) Action of Alkalies on Casein.—Such compounds as caustic soda and potash, ammonia, sodium and potassium carbonate, unite with casein and form compounds that are easily soluble in water. They also dissolve the casein that has been coagulated. Some of these compounds are found in commerce as food preparations. Nutrose is a food preparation that consists mostly of sodium casein.

(e.) Action of Other Compounds on Milk Casein.—Certain chemical compounds, when added to milk in large quantities, coagulate casein, such as common salt, magnesium sulphate (Epsom salt), ammonium sulphate, etc. Other compounds, added in smaller quantities, coagulate casein, such as alum, zinc sulphate, corrosive sublimate, formalin, etc.

(f.) Action of Heat on Casein.—Heat alone under ordinary conditions, even at boiling point, does not coagulate casein in milk. The formation of a peculiar skin on the surface of milk heated above 140 degrees F., is largely due to the casein of the milk, and not to albumin, as was formerly supposed. The skin itself contains practically all the constituents of milk and is a kind of evaporated milk.

(g.) Action of Rennet on Milk-Casein.—One of the most characteristic properties of milk-casein is its coagulation by rennet, this property making it possible to manufacture cheese from milk. The curd formed by action of rennet is a compound different from casein and is called paracasein. The coagulation of casein by rennet is quite different from that produced by acids. In connection with the subject of cheese-making, we will consider in detail the properties of rennet and the conditions that affect its power to coagulate with milk-casein.

(3.) Milk-Albumin.—Milk-albumin differs from milk-casein in many ways, the most important of which we will briefly notice. First, milk-albumin is not acted on by rennet; second, it is not coagulated by acids at ordinary temperatures; third, it is coagulated by heat alone, though not completely, above 160 degrees F. From these characteristic differences, it can readily be seen that casein and albumin are very different compounds.

(4.) Galactase in milk was discovered by Drs. Babcock and Russell about five years ago. It is present in very small amounts. It has the power of acting upon milk-casein, first changing it into a solid and then dissolving it. It is believed to be active in cheese ripening.

(5.) Amount of Casein and Albumin in Milk.—In general, the amount of casein and albumin, taken together, are found in milk in quantities ranging from 2.50 to 6 per cent.; the average is about 3.2 per cent. There is about 3.5 times as much casein as there is albumin.

(a.) Casein.—Casein in milk varies from 2 to 4 per cent., and averages 2.50 per cent.

(b.) Albumin.—Albumin in milk varies from 0.50 to 0.90 per cent., and averages 0.70 per cent.

(c.) Influence of Lactation on Casein and Albumin.—There is a very general tendency for casein and albumin to increase in milk as the period of lactation advances, and somewhat more rapidly in proportion than the milk-fat.

5. Milk Sugar.

Milk-sugar is present in cows' milk in solution. In general composition it resembles our ordinary sugar, but its sweetness is very much less than that of cane sugar, and it is also less readily soluble in water. It is present in milk in amounts varying from 4.5 to 5.5 per cent., and averaging 5 per cent. Its importance in dairy manufacture, especially in connection with butter and cheese, comes from the readiness with which it is converted into lactic acid by various organisms. This action will be studied in detail in the next chapter.

6. The Salts of Milk (or Ash).

The salts of milk, also called the mineral matter, or ash, are important constituents, though they are present in only small quantities, varying from 0.50 to 0.90 per cent., and averaging about 0.70 per cent., as expressed by the ash. The elements which go to make up the salts of milk, stated in the order of their abundance, are the following: Phosphorus, potassium, calcium, chlorine, sodium, magnesium, sulphur and iron. The calcium is probably present in the form of calcium phosphates; the sodium, as sodium chloride; the potassium, as potassium phosphate, chloride and citrate.

7. The Gases of Milk.

Milk contains more or less oxygen and nitrogen, some portions of these gases being carried into it mechanically from the air in the process of milking. It contains also carbon dioxide when freshly drawn, probably between 3 and 4 per cent., a portion of which escapes at once while being milked under usual conditions.

We have now seen, in some detail, how many and what different compounds are contained in milk. There are certain arbitrary divisions of these compounds made for the sake of convenience. One such division makes two classes of the compounds of milk—(1) water and (2) solids, or milk-solids, or total solids, these including fat, casein, albumin, milk-sugar and salts, or ash, of milk. Another division is on the basis of the milk-fat, into (1) fat and (2) milk-serum, this including all the milk except the fat, that is, water, casein, albumin, milk-sugar and ash. Separator skim-milk is nearly pure milk serum. Then, again, the milk-solids themselves are divided into (1) fat and (2) solids-not-fat, the solids-not-fat including the milk serum less the water.

Analyses of Milk.

	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein.	Per cent. of albumin.	Per cent. of sugar.	Per cent. of ash.
Average of 5,552 American analyses compiled by the writer,	87.10	12.90	3.90	2.50	0.70	5.10	0.70
Average cheese-factory milk for the season (May to November) in New York State,	87.40	12.60	3.75	2.45	0.70	5.00	0.70

CHAPTER II.

CONTAMINATION OF MILK.

Milk, on standing, undergoes a variety of changes sooner or later, many of which spoil it for use as food. The most common and extensive changes occurring in milk are due to fermentations. One result of some fermentations is the production of bad flavors, but these may be acquired also either by direct absorption from the surrounding air or from the food consumed. To these different sources of contamination we will now give some detailed attention.

8. What is Fermentation?

The meaning of fermentation can best be made clear by illustration. When a fruit juice, like sweet cider, is allowed to stand at ordinary temperature, it soon begins to undergo changes, large quantities of bubbles of carbon dioxide gas come from the surface of the liquid, and some alcohol is formed. In this case, the sugar of the apple juice is changed into alcohol and carbon dioxide. If this cider, containing alcohol, is allowed to stand long enough at ordinary temperatures, the alcohol disappears, being changed into acetic acid and we then have what we commonly call cider vinegar. The process resulting in the change of the sugar in the cider into alcohol and carbon dioxide is called a fermentation; and that resulting in the change of alcohol into acetic acid or vinegar is also a fermentation.

When milk is freshly drawn, it is sweet, but, on standing a while at ordinary temperature, it becomes sour. The change taking place is the formation of lactic acid from milk sugar, and it is caused by certain germs. The souring of milk is another case of a fermentation.

That which causes fermentation is called a ferment. As there are many different kinds of fermentation, so there are many different kinds of ferments. In the production of alcohol and carbon dioxide from the sugar in cider, the ferment is yeast; in the fermentation of vinegar from alcohol, certain kinds of bacteria are the ferment in the conversion of milk sugar into lactic acid, certain other bacteria constitute the ferment.

Ferments possess certain general characteristics in common, among which may be mentioned the following: (a) A very small amount of ferment is capable of producing very great changes. (b) They are all dependent upon temperature as a condition of activity. They cease to act at low and also at high temperatures. Most of them find the temperature best suited to their greatest activity between 80 and 100 degrees F. (c.) Ferments are destroyed by heat, the temperature of boiling water in most cases completely destroying their power to act. Their activity is checked by low temperatures, but, when again warmed, they renew their activity. (d.) The products which ferments form, when accumulating in certain amounts, usually stop further action. (e.) All ferments are closely connected with life processes.

9. Two General Classes of Ferments.

The different bodies that are capable of causing fermentations may be divided into two general classes (1) organized ferments, and (2) unorganized ferments.

(1.) Organized Ferments are living organisms capable of producing fermentations. Those of greatest interest found in milk and its products are called bacteria. Bacteria are the smallest conceivable forms of plant life. Each individual consists of a single cell, averaging in diameter one-thirty thousandth of an inch. They appear in three general varieties of form: Ball (coccus), short rod (bacillus), and cork-screw (spirillum). They multiply in number or reproduce by simple division; that is, when a cell grows in size, it increases more in one direction, so as to lengthen out slightly, and a partition forms across the cell, thus producing two new cells in place of the old one; and then each of these subdivides again and so on continuously. Some kinds of bacteria form spores in the cells; these are to bacteria what seeds are to higher plants. Spores are not so easily killed by heat as are bacteria. Some bacteria have power of motion. Under favorable conditions, their rapidity of growth is remarkable. In some cases, one cell divides into two cells in twenty minutes; if this rate were kept up for twenty-four hours, the one cell would multiply into several millions. Bacteria require as food for satisfactory growth compounds containing nitrogen, carbon, hydrogen, and, in addition, small amounts of inorganic or mineral matter. The sugar, casein and albumin in milk and its products furnish a supply of food very readily utilized by bacteria. As already stated, bacteria are affected by temperature. The bacteria commonly present in milk grow between the limits of 40 and 110 degrees F., the most favorable temperatures being between 80 and 95 degrees F. Many bacteria are killed between 130 and 140 degrees F., when exposed to this degree of heat for ten minutes, and most are destroyed at 185 degrees F. Many spores are killed at temperatures considerably above 212 degrees F., and even then require one to three hours. Dry heat is less effective than moist heat. Live steam, therefore, affords a most efficient means of destroying bacteria. All bacteria are rendered inactive by low temperatures and some may be killed by intense cold. Many bacteria may retain life even on being dried and become active again when placed under favorable conditions of moisture and temperature. Sunlight kills many bacteria when they are exposed directly to the sun's rays for a few hours. Bacteria are either checked in growth or killed by many chemical compounds. Those compounds that simply retard the rapidity of growth of bacteria are called antiseptics; those that destroy bacterial life are called disinfectants. Bacterial activity is stopped by an accumulation of the products formed by it and, in some cases, by the products of the activity of other bacteria. In the course of their growth, bacteria produce great changes in the materials in which they grow, and the processes by which these changes are brought about are known, as previously stated, under the general name of fermentations. Bacteria are found distributed nearly everywhere in the soil, in the air and in water. They are always present in large numbers wherever vegetable or animal matter is undergoing decay. They are, therefore, always closely associated with dirt and filth. While some are the cause of dreaded diseases, most of them are either harmless or actively helpful in many ways.

(2.) Unorganized Ferments or Enzymes are chemical substances or ferments, without life, capable of causing marked changes in many complex organic compounds, the enzymes themselves undergoing little or no change. Many enzymes are produced directly by bacteria, while many are formed in higher plants and in animals. The pepsin found in the human stomach is an enzyme; its special activity enables it to change proteid compounds from insoluble to soluble forms. The ptyalin contained in saliva is another enzyme, and is capable of changing starch into sugar. Babcock and Russell discovered in milk, a few years ago, an enzyme called galactase, which has the power of coagulating and then dissolving milk-casein. Another enzyme of interest in dairying is rennet, a small amount of which can coagulate many thousand times its own weight of milk. Enzymes are destroyed by high temperatures and by many disinfectants. Some substances, like ether and chloroform, do not seriously interfere with the activity of enzymes, while they do destroy bacterial activity.

10. Sources of Bacteria in Milk.

Milk, when drawn with careful precautions from the udder of a cow, contains comparatively few bacteria; but milk obtained and handled under ordinary conditions, is found to contain large numbers, often several hundred thousand in one cubic centimeter (somewhat less than one-quarter of an ordinary teaspoonful). The more dirt there is in milk, the more bacteria there will be. Bacteria and dirt always go together in dairy matters. The bacteria found in milk come from the following sources:

(1) Dairy Utensils. Primarily the milk-pails, strainers and milk-cans. The cracks and joints of all utensils made of tin, unless great care in cleaning is used, contain dirt that holds large numbers of bacteria. Rust and imperfect soldering of joints furnish places for dirt to get out of easy reach. Without prompt and extreme care, strainers easily become filthy and are then simply breeding places for bacteria. When milk cans are used for carrying back to the farm from the cheese factory or creamery whey or skim-milk, the cans often are not cleaned promptly, and, when finally attended to, are not treated with proper thoroughness. Through the medium of a dirty skim-milk tank or whey-vat, filth germs of one form may be distributed throughout the whole neighborhood. Even epidemics of typhoid fever have been traced to this source of infection.

(2.) Udder Cavity.—The milk first drawn usually contains more bacteria than that drawn later. The end of the teat furnishes a good place for bacteria to grow, and some are able, sooner or later, to penetrate upward through the milk duct into the milk cistern and grow there to some extent. The first streams of milk drawn serve to wash out the lower portion of the milk cistern and the duct, and thus carry down bacteria in larger numbers than appear later.

(3.) Bodies of Cows.—The hair on cows favors the accumulation of dirt and dust. The condition is worse in proportion as cows are not regularly and thoroughly cleaned. Dust particles and hairs, laden with bacteria, are in position to drop into the milk pail. While the hairs and coarse chunks of dirt may be removed from milk by straining, the bacteria are, in large part, washed off into the milk and cannot be removed by any ordinary process of straining.

(4.) Milkers.—The hands and clothing of a milker may easily be loaded with bacteria and thus become a source of infection. Particularly objectionable is the filthy practice of some milkers of moistening the hands with milk.

(5.) Air of Stable.—A dirty condition of the floors, walls and ceilings of a stable all tend to contaminate milk. Any condition in the stable that affords a supply of floating dust at the time of milking furnishes additional bacteria for milk.

11. Sources of Contamination besides Bacteria.

While many of the undesirable flavors of milk are due directly to the result of bacterial action, milk may acquire taints that are not dependent on a bacterial origin. Milk, as it comes from a cow, possesses a peculiar "cowy" odor, due to direct absorption of volatile substances within the animal. This odor usually disappears quickly, when milk is exposed to the air; but it becomes abnormal in quality and persistence when a cow eats such things as leeks, turnips, cabbage, rag-weed, etc., a few hours before milking. If milk is not drawn for eight to twelve hours after such food is eaten, such taints either disappear or are greatly diminished. The same experience in milder form may come from the use of some green fodders, such as rape and green rye, and from the feeding of excessive quantities of swill, brewers' grains and distillery slops.

If milk, after being drawn, is exposed to contact with strong odors, such as those coming from manure or other decaying organic matter, or even from ensilage, it readily absorbs them. Milk, whether warm or cold, possesses a very striking power for absorbing and holding volatile odorous substances.

12. Kinds of Bacteria in Milk.

Many different kinds of bacteria have been found in milk. Some appear to be very generally present, others only rarely. Many of them have little or no appreciable effect upon milk or upon human beings; while some furnish products that are distinctly beneficial, others produce only injurious effects in milk, imparting to it bad flavors or unpleasant appearance, and, in some cases, even causing the formation of violent poison. It is also possible that the bacteria causing dread diseases may be found in milk in some instances. We present below the chief classes or types of bacteria that give rise to the fermentations most commonly occurring in milk.

(1.) Lactic Acid Fermentation or Souring of Milk.—The souring of milk is due to the formation of lactic acid, which is produced by the action of lactic acid bacteria upon the sugar in the milk. In this form of fermentation, one can begin to taste the acid when it amounts to about 0.3 per cent. of the milk. As the amount of acid increases to 0.4 per cent., the milk begins to curdle or thicken, and, as the amount of acid increases above this, the curd becomes more solid. These bacteria continue actively converting milk sugar into lactic acid until the acid reaches 0.8 to 1 per cent. of the milk, and then they cease their activity, because they cannot live in a solution containing this amount of acid. Their activity is stopped by the accumulation of the product of their own activity and not because the supply of milk-sugar runs out, for, when they cease their activity, about three-quarters of the milk sugar still remains unconsumed. There are several different kinds of bacteria that can convert milk sugar into lactic acid. The temperature most favorable to the growth of lactic acid organisms is 90 degrees F. to 95 degrees F. Below 80 degrees F. they gradually lose their activity and practically cease at 50 degrees F. At 105 degrees F. they are fairly inactive, many are killed at 135 degrees F. to 140 degrees F., and at 150 degrees F. to 160 degrees F. all are killed. While this fermentation spoils milk for the taste of most people, it is a very essential factor in the manufacture of butter and cheese, as will be seen later. It is quite commonly thought that milk is peculiarly liable to sour during thunder storms, as the result of some peculiar electrical or other influence. The hot weather preceding such storms favors the more rapid growth of the lactic acid germs, and this is the proper explanation. Milk free from such germs never sours during thunder storms.

Some of the bacteria that act upon milk-sugar form large quantities of gases, especially carbon dioxide and hydrogen, and these gases are responsible in cheese-making for "floating" curds and "huffing" cheese.

(2.) Fermentations Affecting Milk-Casein.—Occasionally milk curdles without souring. This is caused by the action of rennet-like enzymes or ferments which certain bacteria produce. The same bacteria usually produce a second enzyme, which dissolves the coagulated casein. Some bacteria form only the dissolving or digesting enzyme, in which case the casein is slowly rendered soluble without previous coagulation. The bacteria that affect casein do not grow in the presence of lactic acid, and as the lactic acid bacteria usually develop more rapidly, they soon stop the growth of the former. In the absence of lactic acid bacteria, the digesting organisms are apt to grow. There are other forms of fermentation that act upon milk-casein and result in the production of substances having extremely offensive odors and disagreeable taste. In some cases poisonous products are formed, as, for example, tyrotoxicon, commonly known as cheese poison.

(3.) Butyric Acid, or "Rancid" Fermentations.—Some organisms act upon milk-fat or butter-fat, forming free butyric acid, thus producing the odor and taste of "rancid" butter. These bacteria grow slowly under ordinary conditions and do not commonly become active in milk, unless kept a long time, but they find their way into butter and, under favorable conditions, develop there to the disadvantage of the flavor of the butter.

(4.) Less Common Forms of Fermentation in Milk.—The kinds of bacteria described above are found commonly occurring in milk, but there are others which appear only occasionally, and some of these will now be briefly considered.

Most dairymen sometimes have milk that fails to sour or curdle, but after a few hours begins to be slimy and finally can be drawn out in long threads. This condition more commonly appears in cream. The trouble may be due to diseased udder, in which case it is apparent at once when the milk is drawn. The form which does not appear at once after milking is due to bacteria. Other abnormal forms of fermentation in milk result in producing alcohol, bitter milk, soapy flavor, fishy flavor, red, blue and other colors.

(5.) Disease Germs in Milk.—Milk furnishes a medium in which many disease germs can readily develop. Some disease-producing bacteria are capable of being transmitted directly from a diseased cow to a human being through the milk. It is quite generally believed that if milk is taken from a cow suffering with tuberculosis in the udder, it will be fairly sure to contain tuberculosis germs; and such milk taken into a human body may produce tuberculosis. Other disease-producing bacteria may get into the milk after it is drawn, having nothing whatever to do with the cow. Such are germs causing typhoid fever, scarlet fever, diphtheria and diarrhoeal diseases, such as cholera infantum. Such disease germs may get into milk from a case of illness on the premises where the cows are milked, through the carelessness and ignorance of the members of the household.

CHAPTER III.

PREPARATION OF MILK FOR MARKET.

In the preceding chapter we have seen that bacteria of different kinds get into the milk in various ways and, under conditions favorable to their activity, cause fermentations that may result in rendering milk totally unfit for sale. Therefore, the chief aim to be kept in mind in preparing milk directly for market is practically this, how to keep under control the growth of bacteria to such an extent that injurious fermentations shall not take place to any marked degree. Three general methods are in use for securing control of fermentations in milk: (1) Keeping bacteria from getting into milk, (2) preventing growth of bacteria already in milk, and (3) destroying bacteria already in milk. We will now consider these methods separately.

13. Keeping Bacteria from getting into Milk.

We have previously seen that the common sources which are responsible for furnishing the bacteria that are found in milk are (1) the air of the stable, (2) the body of the cow, (3) the person of the milker, and (4) the dairy utensils with which the milk comes into contact. We have also seen that the one common source of bacteria in all these cases is dirt. Hence, the one thing needful to prevent bacteria getting into milk is extreme cleanliness at every point of contact with the milk. The following suggestions are given to indicate what is meant by cleanliness in connection with milking and caring for milk.

(1.) The Stable.—Every condition about the stable should be regulated with reference to absence of dirt, an abundant supply of pure air, and a direct exposure to sunlight. The floors should be tight and of a material not readily absorbing liquids. An abundance of clean bedding should be used, and the manure should be removed more frequently than once a day, and, in any case, not immediately before milking. The walls and ceiling should be swept often enough to prevent the accumulation of dust. Once a year, at least, it is wise to clean the whole stable with extreme care and then go over the whole with a generous coat of whitewash. At such a time, the stable should be thoroughly disinfected, if there have been any contagious diseases in the stable. The surroundings outside of the stable should be kept in a clean condition, so as not to interfere with the supply of pure air.

(2.) The Body of the Cow.—Too much pains cannot be taken to keep the cows clean. In addition to regular currying and brushing all over, the udder and adjacent portions of the body should be carefully brushed before milking and also wiped with a damp, clean cloth. The udder should also be wiped after milking.

(3.) The Milker should wash his hands carefully before milking and have them perfectly dry while milking. It is also desirable to have a special coat or jacket for milking, made of some material that will not catch or hold dust easily.

(4.) The Dairy Utensils.—All utensils that come in contact with the milk, such as milk-pails, milk-cans, aerators, etc., should be made of metal, preferably of pressed tin, with smooth, well-flushed joints and perfect seams. They should be kept entirely free from rust. Such vessels should never be allowed to dry when dirty, as dried particles of milk are particularly difficult to remove. In cleaning dairy utensils, rinse them first with lukewarm water and then wash them thoroughly in hot water, using soap or washing soda. Then rinse them with hot water and complete the cleansing, if possible, by exposing to a jet of live steam for three to five minutes.

When practicable, expose them finally to direct sunlight for a few hours. Strainers should be washed immediately after using, cleaning first in tepid water, following with hot water and soap and finally with hot water and steaming or boiling.

(5.) Time of Feeding.—Foods having marked odors should be fed only after milking and then at once, and none should be left in the stable. Dry fodders, which furnish dust, should likewise be fed after milking.

(6.) Diseased Milk.—The milk of diseased animals should not be used nor that of animals fresh in milk before the ninth milking.

(7.) Contagious Diseases.—No person suffering from, or recovering from, a contagious disease, nor any person that has anything to do in caring for such a person should be allowed to have any contact with the dairy.

(8.) Removal from Stable and Subsequent Treatment.—As soon as each cow is milked, the milk should be removed from the stable to some room free from all bad odors and with cleanly surroundings. The milk should be at once strained through a brass-wire strainer, having not less than fifty meshes to the inch, and also through three or four thicknesses of cheese-cloth. Still more effective results in straining can be secured by the use of absorbent cotton, though its expense makes its use impracticable under ordinary conditions. After straining, cool to 50 degrees F., or below.

By observing precautions like these, it is easily possible to reduce the number of bacteria in the milk to such an extent that the milk will keep eighteen to twenty-four hours longer than ordinary milk. Precautions like the foregoing for keeping bacteria out of milk are practicable, where one owns a herd of cows and has all conditions under personal control; but it is another matter when it comes to making some one else observe them. So, when milk is not under one's control, the next best thing is to prevent the growth of the bacteria already in the milk, and this may be done by use of low temperature in keeping the milk or by heating the milk first and then cooling. One method prevents or delays the growth of bacteria without destroying the germs themselves, while the other destroys most of the bacteria.

14. Preventing or Delaying Growth of Bacteria in Milk.

Whether precautions have been taken or not to keep large numbers of bacteria from getting into milk, it is necessary, as soon as milk is drawn, to cool it quickly, and the lower the temperature, the better. At temperatures below 50 degrees F., the rapidity of growth of the bacteria is greatly lessened. In connection with the cooling of milk, it is well, at the same time, to aerate it, in order to remove the natural "animal" odor or any other odor that may have been absorbed by the milk after milking. There are several special forms of aerators in the market (see Figs. 1 and 2) that serve for both cooling and aerating the milk at the same time. The main points to be considered in selecting an aerator or a combined aerator and cooler, are simplicity of construction, ease of management, effectiveness in cooling and aerating and convenience in keeping clean. Aeration must always take place in an atmosphere as free as possible from bacteria; otherwise the process will only increase the number. The use of low temperatures in keeping milk gives the best results only with the milk that is most free from bacteria.

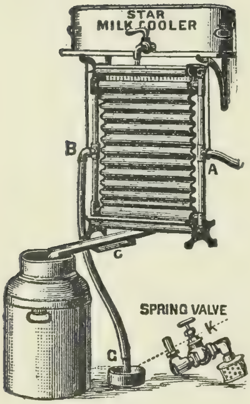

Fig. 1.

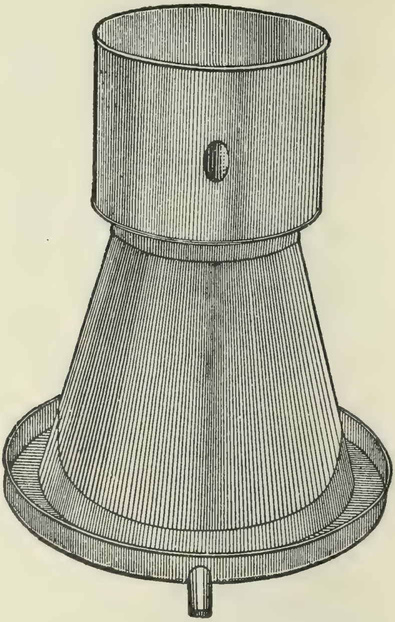

Fig. 2. Champion cooler and aërator.

15. Destroying Bacteria in Milk.

In the case of milk that contains large numbers of germs, the most effective way to keep the milk from souring and from the development of other forms of fermentation is to destroy the bacteria. This may be best accomplished by heating the milk. While it is possible to add to milk chemicals that will destroy bacteria without affecting the composition or taste of the milk, the use of preservatives is very generally condemned for this purpose on the ground that they may injuriously affect the health of people using milk thus treated. The use of preservatives, such as salicylic acid, boracic acid, formalin, etc., for the purpose of keeping milk is not to be recommended. In employing heat to kill bacteria, two general methods have been used, known as pasteurizing and sterilizing.

(1.) Pasteurizing Milk.—In pasteurizing milk for market, it is heated to 140 degrees F., and held at that temperature for twenty or thirty minutes. Formerly, higher temperatures were used, but it was found that milk, heated above 156 degrees F. acquired a "cooked" taste and that the cream did not readily rise. While the lower temperature does not destroy all germs, it destroys most of them and greatly improves the keeping power of milk. To secure best results in pasteurizing, it is desirable to use milk as fresh as possible. Milk containing 0.2 per cent of lactic acid does not give good results. The fewer bacteria milk contains before pasteurizing, the better will be the results of pasteurization. It is also very essential in pasteurizing that the heated milk should be cooled down at once to 50 degrees F., or lower. It should also be stored in germ-free bottles or other vessels and kept cold until it is delivered to the customers. When used by children, pasteurized milk should be consumed within twenty-four hours after treatment. If pasteurization is properly carried out, the milk should remain sweet, even at ordinary temperatures, one and one-half to two days longer than ordinary milk not so treated.

There are on the market several forms of machines for pasteurizing milk. The best machine should possess the following qualifications: (a) Compact form, (b) ease of keeping clean, (c) complete control of temperature, (d) ability to heat milk quickly, completely and uniformly, (e) freedom from liability of additional germs getting into the milk during the operation of pasteurizing.

The pasteurization of milk has the following advantages: (a) It increases the keeping quality of milk. (b) It destroys disease-germs, especially those of tuberculosis. (c) The taste and digestibility of milk are not changed. (d) The process is practicable on a large or small scale.

(2.) Sterilizing Milk.—In order to render milk absolutely free from all bacteria and their spores, it is necessary to heat milk above 212 degrees F. for an hour on each of three successive days, thus giving all spores a chance to develop into active forms, which are then more readily killed. Simple boiling is effective in destroying practically all living disease-germs. Sterilized milk is objectionable for several reasons: (a) It has the characteristic taste of "cooked" milk, which is unpleasant to most people. If people had only sterilized milk to drink, very much less would be used. (b) Sterilized milk appears to be less digestible, especially in the case of children and invalids.

CHAPTER IV.

CREAM.

16. Composition of Cream.

Cream is the fluid product, rich in milk-fat, obtained by removing milk-fat from milk in any manner, along with some portions of other milk constituents. Cream contains the same constituents as milk, but in very different relative proportions. Cream contains much more fat than does milk, but less of the other constituents. Cream varies greatly in its fat content, ranging all the way up from 10 per cent. or less. Market cream often contains less than 15 per cent. of fat, but good cream for domestic use, at the prices commonly charged, should contain 20 to 25 per cent. of fat. The amount of fat in cream depends upon a variety of conditions, but chiefly the method employed in removing the cream from the milk. For illustration, we give the composition of several different samples of cream in the following table:

Per cent. of water.	Per cent. of fat.	Per cent. of casein and albumin.	Per cent. of sugar.	Per cent. of ash.
76.60	15.0	3.1	4.5	0.6
66.30	25.0	3.2	4.8	0.7
62.40	31.5	2.6	3.0	0.5
39.40	56.0	1.6	2.3	0.4

In the separation of cream, the individual fat-globules are not in any way affected; they are simply crowded together in less space than in milk.

17. Separation of Cream.

The fat-globules in milk are relatively lighter than the milk-serum, in which they float free in the form of an emulsion. When milk is permitted to remain quiet in a vessel, the fat tends to rise and accumulate at the surface of the liquid, owing to its lighter specific gravity, relative to milk-serum. In thus passing up through the milk, the fat-globules mechanically carry with them some of the milk-serum. Until recent years, cream was all produced by allowing the fat-globules to separate by gravity, but there have come into gradual use machines that are used to separate cream from milk by means of centrifugal force. Hence, we have in use two general methods of cream separation, (1) the gravity system, and (2) the centrifugal or separator system.

18. Gravity Method of Cream Separation.

The gravity method of cream separation has been used in two different forms, one known as the "shallow-pan" system and the other as the "deep-setting" system.

(1.) Cream Raising by Shallow-Pan System.—This is the oldest method employed in separating cream from milk. It is still employed in many small dairies. To obtain the best results with this method, the milk should be placed in the pans at once after milking and should be cooled to 60 degrees F. within a reasonably short time, and should then remain quiet at about that temperature for thirty-six hours or more. The depth of milk in the pan may be from two to four inches. When cold running water can be used to surround the pans ,the depth may be from four to six inches. Ordinarily a cool, clean cellar, well ventilated, furnishes good conditions. Any place where the milk can be exposed to bad odors or to dust should be avoided. There are some serious objections to this method of creaming, among which may be mentioned (a) exposure of a large surface of milk to air for a long time, thus giving unusual opportunity for bacteria to get into the milk; (b) a temperature permitting the rapid increase of bacteria by growth; (c) incomplete separation of fat-globules from the milk serum; (d) wasteful loss of cream in skimming; (e) drying out of cream, making it liable to go into butter in dried chunks and injure the texture. (f) The amount of acid in the cream is apt to become too great, thus injuring the flavor of the butter. It has been found that skim-milk obtained by the shallow-pan system of creaming seldom contains less than 0.5 per cent. of fat, while the average of actual practice is much higher, amounting to about one-fifth of the entire fat present in the milk.

(2.) Cream Raising by Deep-Setting System.—This method has been in use between thirty and forty years, probably reaching its most extensive use ten years ago. It was found that by using long pails or cans, not more than a foot in diameter, and placing these, filled with fresh milk, in a tank of water kept at 40 degrees F., the cream would separate more completely and in much less time than it would when raised in shallow pans, twelve to twenty-four hours being sufficient for the separation. This system is capable of reducing the loss of fat in skim-milk to 0.2 per cent., when the most favorable conditions are present. This method also has the advantage of greatly diminishing the amount of exposure to air, thus preventing additional bacteria getting into the milk from the air during the creaming process. Owing to the low temperature employed, the growth of bacteria in the milk is greatly retarded. To use this system satisfactorily, ice is necessary. The cream raised by the deep-setting method is not very rich, usually containing between 15 and 20 per cent. of fat.

In the gravity method of cream-raising, the rapidity and completeness of separation of cream are dependent upon several different factors, among which may be mentioned (a) the size of the fat-globules, (b) the amount of solids in the milk-serum (the solids-not-fat), and (c) the relative proportions of the different solids in the serum. The larger fat-globules separate from the milk more quickly than the smaller ones do. The size of fat-globules varies with individual cows, with breeds, with advance of the period of lactation, and with other conditions. The fat-globules in the milk of cows fresh in milk are larger than later in the lactation period, decreasing in size as the cow is farther from the beginning of her period of lactation. The solids-not-fat in milk, that is, the casein, albumin, sugar and mineral salts cause milk to have the property of what is called *viscosity;* by this is meant the power of adhering to other solid things. The presence of these solids in milk gives milk the power of adhering to fat-globules, thus offering resistance to their tendency to rise or move in any direction. Now, the greater the amount of these solids-not-fat in milk, the more opposition do the fat-globules have to overcome in rising, and the more slowly and incompletely does such milk cream. It is well known that, as a cow gets farther along in her lactation period, the casein and albumin increase more rapidly than do other constituents and they greatly increase this viscosity of the milk. Hence, with advance of lactation, we have two different factors increasing all the time in the milk that interfere with the raising of the cream, viz: decrease in size of fat-globules and increase of viscosity. This explains why the gravity method of creaming gives less satisfactory results when a cow is far along in milk than when she is fresh. To overcome these adverse conditions, various expedients have been tried, the most common being dilution of the milk by water, both warm and cold. The advantages secured in this way are doubtful and the disadvantages accompanying such a practice are considerable.

19. Separation of Cream by Centrifugal Force.

It is not our purpose to discuss the details of the mechanism of centrifugal machines or to describe the different varieties in the market. We intend simply to make a few statements in regard to the general principles applying to their use and the results secured. There are on the market many different forms of these machines, and between many of them there is very little choice in respect to their relative efficiency. If any one, not well informed about separators, plans to purchase one, it is suggested that it would be desirable to correspond with the Experiment Station at State College and obtain authoritative advice in regard to the qualities of different machines rather than to rely wholly upon the persuasive statements of agents who are ambitious to sell machines.

All centrifugals designed for separating cream from milk are based upon the same general principle. The milk enters a rapidly whirling bowl and at once partakes of the centrifugal motion, being thrown by the centrifugal force to the extreme wall of the bowl. As the milk continues to flow in, the bowl fills from the outside toward the center. The centrifugal force acts more strongly upon the heavier portion of the milk, that is, the milk serum or all the milk except the fat. Hence, the milk-serum is forced to the outside wall of the bowl, while the lighter portion of the milk, the fat with some adhering serum, is forced to the center. Tubes connect with the skim-milk layer at the outer wall and with the cream layer at the center of the bowl to carry away these products as they accumulate. The outer walls of the separator bowl gradually become covered with some of the solid, heavier constituents of the milk, including solid dirt present in the milk, forming what is known as "separator slime," the composition of which we will notice later.

(1.) Conditions Affecting Creaming Efficiency of Separators.—The efficiency with which separators remove cream from milk depends upon several different conditions, some of which we will briefly consider.

(a.) The intensity of centrifugal force affects the efficiency of a separator. This increases as the diameter of the bowl increases and also when the bowl whirls rapidly. So, the larger the bowl, and the greater the speed of the bowl, the greater is the contrifugal force and also the creaming efficiency.

(b.) The rate at which the milk flows into the separator bowl affects the creaming efficiency. The more slowly the milk flows in, the longer it is under the action of the centrifugal force and the more completely is the fat removed from the milk.

(c.) The temperature of the milk when run through the separator affects the creaming efficiency. The warmer the milk, the more easily the fat separates. The temperature commonly employed is from 76 to 98 degrees F. In producing cream for butter-making, the milk should be separated at as low a temperature as possible without diminishing the creaming efficiency, because heating the fat-globules above a moderate temperature tends to produce butter of soft texture.

(2.) Regulating Richness of Cream.—The richness of cream produced by a separator is regulated by the rate at which the milk flows into the bowl and by the rapidity with which the bowl revolves. The more rapid the inflow of milk or the slower the speed of the bowl, the larger the quantity of cream and the poorer in fat. Most machines are provided with special arrangements for regulating the richness of cream without changing the rate of inflow or rapidity of motion.

(3.) Creaming Efficiency of Separators.—A good centrifugal separator should not leave more than one-tenth of one per cent. (0.1 per cent.) of fat in the skim-milk, when it is run under proper conditions.

(4.) Promptness in Separating Milk.—Milk should be separated as soon as practicable after milking, and the cream should be cooled down to 50 degrees F., or below.

(5.) Advantages of Creaming by Centrifugal Machines.—Among the advantages that may be mentioned in favor of employing centrifugal machines in separating cream from milk are the following:

(a.) There is a great saving of fat. Gravity systems of creaming leave, on an average, 0.5 per cent. of fat or more in the skim-milk, while good separators properly handled should not leave more than 0.1 per cent. In a large number of comparative experiments made by the writer, where milk from different breeds of cows was creamed both by the deep-setting gravity system and by centrifugal machine, it was found that the separator effected a saving of fat amounting to twenty-four to sixty-five pounds a year for each cow. In the form of butter, at twenty cents a pound, this saving for each cow would be equivalent to $5.00 to $15.00 a year.

(b.) In the case of cream separation by the gravity system, the composition of the cream is not under satisfactory control, and will vary, even under the most uniform conditions of creaming, 5 per cent. of fat or more. One can never be sure in advance of what the fat content of gravity-raised cream will be. In the case of cream separated by a centrifugal machine, one can so regulate the conditions as to produce cream with just the desired amount of fat in it. It is thus easy to produce a product that is uniform in composition, since the conditions are under easy control. In the case of producing cream for sale as such, it is very important that the product shall be uniform from day to day.

(c.) Separator cream is more free from dirt and bacteria and will keep longer than will gravity cream. Most of the dirt in milk in the form of solid particles is completely removed by the centrifugal separator, as the appearance of the separator slime abundantly testifies.

(d.) The skim-milk produced by separator creaming is sweeter and more free from bacteria and dirt than that produced by gravity creaming. Separator skim-milk is, therefore, better for feeding purposes.

20. Artificial Thickening of Pasteurized Cream.

When cream is prepared to sell for immediate consumption as cream, its keeping power can be very greatly increased by pasteurizing at 140 degree F., without affecting its taste. However, some of the physical properties of the cream are so changed by pasteurizing that it appears thinner after pasteurization, though containing the same amount of fat. Pasteurized cream, therefore, gives the impression of being poorer in fat, and is much more difficult to make whipped cream from. Babcock and Russell have devised a simple, effective and absolutely harmless method of restoring the proper consistency or body, to pasteurized cream. This consists in the addition of a small amount of "viscogen," which is an entirely harmless compound made from lime-water and ordinary granulated sugar. Viscogen is prepared as follows: Take two and one-half parts, by weight, of granulated sugar and dissolve in five parts of water. To this add some lime-water prepared thus: To one part of quick-lime add three parts of water, stir thoroughly until the lime is completely slaked, strain and this liquid, which is simply lime-water, is added to the solution of cane sugar. The mixture of lime-water and cane sugar is shaken or stirred at intervals for two or three hours, after which it is allowed to stand until settled. Then the cleared liquid is poured off and stored in tightly-stoppered bottles ready for use. Of this liquid, thus prepared, add one ounce to three gallons of cream and stir thoroughly. Sometimes a little more is needed. As many States have stringent laws against the addition of any kind of foreign substance to milk or cream, cream to which viscogen has been added should not be sold as simple cream, but as a special preparation of cream. Moreover, customers should be given the choice of buying cream with or without viscogen, as some people have a prejudice against additions of any kind to their dairy food products. However, the use of viscogen is just as harmless to health as the use of so much common salt.

21. Profits Derived from Selling Cream.

There is no form under which milk can be sold at so great a net profit as in the form of cream. The labor involved and the cost of preparation are much less than in the case of making butter or cheese. The skim-milk may all be kept on the farm, while in the case of milk-selling and cheese-making there is none. At the market rates commonly prevailing for dairy products, the price received for cream is higher, relative to its cost of production, than is the price of an equivalent amount of milk, butter or cheese. An investigation made by the writer some years ago indicated that the net profit from selling cream is nearly three times that from butter, nearly four times that from selling milk and about seven times that from selling cheese. While the demand for cream is limited, it has been steadily increasing. Any dairyman, so circumstanced that he can dispose of his milk in the form of cream directly to customers, should make an effort to develop this form of trade.

22. Composition of Skim-Milk.

Skim-milk is the product, containing water and milk-solids that remains when any portion of fat normally present is removed from milk in the form of cream by any means whatever. It is essentially milk-serum with some milk-fat in it. Skim-milk varies in composition according to the composition of the milk before skimming, and according to the method of creaming.

(1.) Difference in Composition of Gravity and Separator Skim-Milk.—Separator skim-milk differs in composition from gravity skim-milk chiefly in the amount of fat present. The following figures serve as a good illustration to show the difference in such composition:

	Gravity skim-milk — Per cent.	Separator skim-milk—Per cent.
Water,	90.00	90.30
Fat,	0.50	0.10
Casein and albumin,	3.50	3.55
Milk-sugar,	5.20	5.25
Ash,	0.80	0.80

(2.) Difference in Composition of Skim-Milk from Different Kinds of Milk.—We will illustrate next the difference in composition of skim-milk due to difference in composition of the original milk before skimming. For this purpose, we will consider only the total solids of the milk, as this will sufficiently illustrate the point we wish to bring out. We will assume that each of the milks represented is creamed by a separator and that all of the fat but one-tenth of one per cent. is removed:

	Per cent. of total solids in milk.	Per cent. of fat in milk.	Per cent. of total solids in skim-milk.
Milk No. 1,	11.80	3.30	8.90
Milk No. 2,	12.65	3.60	9.50
Milk No. 3,	14.50	4.60	10.50

There has been common an idea that the skim-milk from milk rich in fat is of inferior quality to skim-milk from milk less rich in fat. The figures above show that this idea is erroneous. The richer a milk is in fat, the richer it is in solids-not-fat, that is, skim-milk solids. A hundred pounds of skim-milk from rich milk contains more casein, albumin and milk-sugar, as a rule, than will a hundred pounds of skim-milk less rich in fat, provided, of course, that the method of removing fat is the same.

Some writers have made a distinction in name between skim-milk obtained by the gravity process of creaming and that obtained by the separator process, calling only the former skim-milk, and applying the term "separated milk" to separated skim-milk. The distinction is without justification and quite uncalled for, since skim-milk is the product left after removing fat from milk, without reference to the method employed in removing the fat.

23. Valuable Uses of Skim-Milk.

Skim-milk has come to have a variety of uses, giving it a definite value. To the dairy farmer, the most valuable use to which he can put skim-milk is, undoubtedly, as food for animals. The composition of skim-milk, as given above, shows considerable quantities of casein and albumin and milk sugar, all of which are important food constituents in forms readily digestible. Skim-milk should preferably be fed sweet, as some of the sugar is lost by fermentation, and marked acidity does not always agree with the digestion of young animals. Skim-milk may be fed to advantage in connection with other foods to all kinds of farm animals.

Skim-milk is also a valuable food for human beings, both in the form of a beverage and in cooking. It should be used much more extensively than it is. Unfortunately, dishonest milk dealers have tried fraudulently to sell skim-milk as whole milk, so that the sale of skim-milk has to be attended with annoying restrictions.

Skim-milk is also used in considerable quantities in the manufacture of cottage-cheese.

The casein of skim-milk is used for a variety of purposes, among which may be mentioned, its use as sizing or dressing in the manufacture of paper as a substitute for celluloid, and as a constituent of plastics for a great variety of purposes.

24. Composition of Separator-Slime.

The separator-slime, which collects on the walls inside the separator-bowl, consists largely of milk-casein, in which are collected all kinds of solid impurities contained in the milk, such as dust, fine particles of hay, ground grain, dung, cow hairs, etc. It is heavily loaded with bacteria. The chemical composition of separator-slime is about as follows:

	Per cent.
Water,	67.0
Fat,	1.0
Casein,	26.0
Milk-sugar,	2.0
Ash,	4.0

On an average, 2,500 pounds of milk produce one pound of separator slime. The amount increases with the amount of dirt present in the milk.

CHAPTER V.

BUTTER-MAKING.

In taking up the subject of butter-making, we assume that we have the cream to start with. The question is sometimes asked why it is necessary to remove cream from milk for butter-making, why not churn the milk itself? Experiments in churning milk have never succeeded in removing the fat from the milk at all completely and the method results in large losses of fat with consequent decrease in yield of butter.

In the case of cream that has been separated by a centrifugal machine, it is important to cool the cream to 50 degrees F. or below, without delay, and to hold it at this temperature for six or eight hours. This cooling appears to be important, in order to obtain butter with sufficiently firm texture. In general, it may be said that we shall be most successful in making butter having the best texture, when the milk and cream are subjected to the fewest changes of temperature and when the changes of temperature that are needed are made in the most gradual, uniform manner.

After having the cream in the condition indicated above, we perform the following different operations in making butter:

(1.) Ripening the cream.
(2.) Churning.
(3.) Washing and working.
(4.) Salting.
(5.) Packing.

After considering the composition of butter, we will take up, in their proper order, the different operations required for making butter.

25. Composition of Butter.

The composition of butter varies considerably, according to the methods and conditions of manufacture. The principal variations are in the fat and water. The following tabulated statement serves to give an idea of the usual limits of variation in composition of American butters, but there are extreme cases lying outside the limits here given:

Per Cent. in Butter.	Low.	High.	Average.
Water,	10.0	15.0	13.0
Fat,	80.0	85.0	83.5
Casein,	0.5	2.0	1.0
Ash (salt),	1.0	4.0	2.5

Good commercial butter should contain over 80 per cent. of fat, and not more than 15 per cent. of water or 3 per cent. of casein.

26. Ripening Cream for Butter-Making.

The ripening of cream is essentially the process of developing enormous numbers of certain kinds of bacteria in cream, the most prominent ones in point of numbers and visible activity being lactic acid bacteria. When butter is made in the old way, the cream is allowed to stand until it ripens spontaneously, no attempt being made to control the process. As the result of the fermentations that occur in the ripening process, many complex changes take place in cream, the details of which are not fully understood. The most obvious results brought about by cream-ripening may be included under three general heads; (1) The formation of lactic acid, (2) the development of products that have charactertistic odors, and (3) the formation of substances that yield a characteristic taste on the tongue. To what extent these effects are produced by special organisms, we have little detailed knowledge, aside from the work of lactic acid bacteria in producing lactic acid. The real sources of the flavors of ripened cream we do not know specifically, nor do we know what these specific compounds are that give rise to the flavors. The amount of lactic acid formed is used as a measure of the extent or degree of cream-ripening, but other forms of fermentation are known to be present at the same time, at least during the early portion of the ripening process. Butter may be made from cream that has not been ripened at all, that is, from sweet cream, or it may be made with the help of artificial acid added to cream, but in neither case do we make a product that is in flavor like butter made from ripened cream.

27. How Lactic Acid is Produced in Cream Ripening.

In order to have the lactic acid fermentation of cream ripening, lactic acid bacteria must be present in the cream and the cream must be kept at a temperature favorable to their growth. We may leave the cream to receive the bacteria by chance, or we may introduce them into the cream purposely. In the old-style method of butter-making, the former method is employed. We have already seen (section 12, p. 25), that milk nearly always contains lactic acid bacteria. During the operation of creaming, these bacteria usually develop to such an extent that, when the cream is exposed to higher temperatures, fermentation proceeds rapidly. However, under such circumstances, the rate of fermentation is not uniform in different lots of cream; at one time more lactic acid is formed, and at another less, during a given time, because the number of bacteria will inevitably vary greatly when their introduction is left to chance.

The formation of lactic acid can be controlled in respect to time and quantity, when we introduce the lactic acid bacteria purposely in sufficient quantities. Material, containing large numbers of lactic acid organisms, which is used to add to milk or cream for the purpose of causing lactic acid fermentation, is known as a "starter." There are two varieties or sources of starters, (1) natural, and (2) pure cultures.

(1.) Natural Starters.—Among the materials used as natural starters in butter-making are buttermilk and cream from previous operations of butter-making, and whole milk or skim-milk soured under special conditions. While there are different ways of preparing natural home-made starters, the following method may be suggested as one that will give good results, if properly carried out: Milk is taken from a cow in perfect health, not too far along in lactation, and kept under proper conditions of cleanliness. The udder and under parts of the cow's body are brushed and then wiped with a damp cloth, after which the cow is milked into a carefully cleaned vessel, the first few streams of milk from the udder being thrown away. The milk thus drawn is at once covered, taken to the dairy and run through the separator. This skim-milk, put into a carefully cleaned receptacle, is carefully covered, brought to a temperature of 90 degrees F., after which it is placed where it will keep at a temperature of 65 degrees F. to 70 degrees F. In twenty to twenty-four hours, the skim-milk will be found properly ripened or just moderately thickened. In using this prepared starter for ripening cream, the upper portion to the depth of one or two inches is removed and thrown away, the rest is strained through a fine strainer or hair seive into the cream, which should be at 70 degrees F., in the proportion of two pounds of starter for 100 pounds of cream. The starter should be thoroughly stirred into the cream, the cream vat covered and kept at a temperature of 65 degrees F. to 70 degrees F. Usually twenty-four hours will develop the proper amount of acid for churning. When the cream is properly ripened, it should just form a soft curd, not a hard curd. In case of over-ripening, when the curd becomes too hard, there is danger that some of this coagulated casein will get into the butter and injure its quality and appearance. Some of this prepared starter, described above, may be used in preparing a starter for the day following, putting a little into skim-milk that has been heated to 180 degrees F. for thirty minutes and then cooled down to 70 degrees F., and the starter may thus be propagated from day to day; but this method of propagating must not be continued too long, as the starter gradually becomes inoculated with undesirable forms of bacteria and sooner or later is unfit for use. These natural starters may be used in either pasteurized or unpasteurized cream.

(2.) Pure-Culture Starters are special preparations consisting of certain specific selected organisms, known to be adapted to the work of cream ripening. There are on the market several different preparations for ripening cream, consisting of special cultures. Such commercial artificial ferments give the best results, when used in pasteurized cream. The chief advantage found by experience to come from the use of these pure culture starters is uniformity in character of the butter produced and better keeping quality. Full directions for methods of use always accompany these special starters and we do not need to consider them here.

28. Amount of Acid Needed for Cream Ripening.

The ripening of cream was, for a long time, the most difficult step of butter-making to control, and the specially difficult point in this operation was to determine the amount of acid that should be present before churning. The appearance, odor and taste of the cream are guides, to some extent, as to the amount of acid formed, but they are far from reliable for accurate, uniform work. It is very important that the same amount of acid shall be developed from day to day in order to secure butter of uniform quality. When cream is ripened so as to show a test of five-tenths to six-tenths of one per cent. of lactic acid, it produces a higher flavored butter than that produced by cream ripened to four-tenths of one per cent. of acid. When cream contains more than sixty-five hundredths of one per cent. of acid, the flavor of the butter is too strong. Moreover, in such cases, the particles of coagulated casein become very hard and form white specks in the butter. Such butter acquires bad flavors quickly. The whey should never separate from the curd in cream ripening. We now have an inexpensive, simple method for determining the amount of acid in cream, and, while the method is not strictly accurate, it is sufficiently close for all practical purposes in cream ripening. For careful work in butter-making, this method of determining the amount of acid in cream should always be used. The method is fully described in section 90, p. 111, Chapter XI.

29. Effects Produced by Cream Ripening.

The effects of cream ripening are seen in several different ways, among which we will notice the more important.

(1.) Improved Flavor of Butter.—In order to secure butter with the kind of flavor required by the average consumer, it appears to be necessary to ripen cream. This is probably the most important and far-reaching effect of ripening cream. The importance of flavor in butter is easily obvious, when we consider that flavor more than any other factor determines the market price of butter. Poor cream ripening means poor flavor and low price for butter.

(2.) Ease of Churning.—It has been found true, especially in cream raised by the gravity system, that cream churns more readily when ripened. This is probably due to the influence of acid upon casein.

(3.) Increased Yield of Butter.—In ripened cream, churning appears to remove the fat more completely from the cream, especially in the case of gravity-raised cream, and, consequently, the yield of butter is greater.

(4.) Better Keeping Quality of Butter.—It is quite generally believed that the keeping quality of butter is better when made from properly ripened cream than from cream improperly ripened.

(5.) Greater Uniformity in Quality of Butter.—It is undoubtedly true that only by the use of properly ripened cream is it possible to produce butter that is uniform in quality from day to day. This is a matter of the first importance to butter makers, because the same customers want the same kind of butter, when they once get the kind that suits them.

30. Mixing Cream of Different Ages.

It often happens that when the amount of cream produced in a day is small, that the cream each day is set aside and additions of new cream made from day to day, until enough has been accumulated for churning. There results a mixture of cream varying in degrees of ripeness. The different portions vary in the length of time in which they will churn, one portion requiring less churning than another. The result is that churning is stopped before all the fat has been removed from the cream and much fat is lost in the buttermilk. The flavor of butter made from such cream can hardly be as uniform as that made from cream uniformly ripened. If different creams, varying in degree of ripeness, are to be churned together, it is essential that they should be mixed together, at least twelve hours before churning; then the degree of acidity will be uniform throughout the entire mass of cream.

31. Pasteurizing Cream for Butter-Making.

In pasteurizing cream for butter-making, less care is required than when cream is pasteurized for direct consumption. The cooked taste occurring in cream when heated above 156 degrees F. is absent from butter made from such cream, even when cream has been heated at high as 185 degrees F. High heating of cream, however, acts injuriously upon the texture of the butter. In using pasteurized cream for butter-making, the heated cream should be quickly and completely cooled after pasteurization, and the ripened cream should be chilled to 48 degrees F. for about two hours before churning. Treatment in this manner overcomes the tendency of any injury occurring to the grain or texture of the butter.

32. Richness of Cream for Butter-Making.

How rich in fat should cream be made for butter-making? By the gravity method of creaming, we obtain cream containing 15 to 20 per cent. of fat, and by the separator we produce cream of any fat content desired. Good results in every respect may be obtained by the use of cream varying greatly in fat content. The tendency has been to use rather rich cream containing 35 to 40 per cent. of fat, in which case a lower temperature is used in churning, usually with loss of less fat in buttermilk. In order to ripen rich cream in the same length of time as poorer cream, somewhat more starter needs to be used, as the richer cream ripens more slowly than poorer cream under the same conditions.

33. Conditions Affecting Churning.

Churning is the term applied to the process by which the fat-globules of milk or cream are made to unite into visible aggregations, and to separate from the milk-serum or buttermilk. This massing together of fat-golbules is usually produced by the vigorous agitation of cream in vessels especially constructed for the purpose, called churns. When milk or cream is agitated at a temperature somewhat below 85 degrees F., the average melting-point of milk-fat, the fat-globules gradually attach themselves together, each of the small masses first formed continuing to increase in size by uniting with others, until finally the whole of the fat, thus separated, can be collected in one mass. The readiness with which fat-globules separate from cream in churning is influenced by several conditions, among which we may mention, as the most important, (1) the composition and size of the fat-globules, (2) the composition of the milk-serum, (3) the degree of ripeness of the cream, (4) the temperature used in churning, and (5) the kind of agitation or churn.

(1.) Composition and Size of Fat-Globules.—The readiness of fat-globules to separate from milk-serum and unite in visible masses during the process of churning, is influenced by the composition and size of the fat-globules. As pointed out in section 3, p. 13, milk-fat varies in its composition, and this variation in composition affects the hardness or softness of the fat. This quality is influenced by the character of the cow's food. Thus, succulent feeds and feeds rich in starch and sugar make the fat softer. Cottonseed-meal makes the fat harder. Now, it is known that the fat-globules unite more easily in churning when they are composed of softer fat, and less readily when they have larger proportions of hard fat.

In respect to the influence of the size of fat-globules upon ease of churning, the larger the fat-globules the more easily and quickly they unite. Owing to their size, the larger ones come into contact more quickly and more often than do the smaller ones.

(2.) Composition of Milk-Serum.—The albumin, casein and milk-sugar contained in milk or cream tend to keep the fat-globules from coming together easily. The larger the amounts of these constituents, the less readily will the fat-globules come together. This is one of the reasons why churning is often so slow and difficult in the case of cream from the milk of cows far along in lactation, since at that time milk contains larger proportions of these constituents than earlier in lactation.

(3.) Degree of Ripeness of Cream.—The fat-globules of ripened cream churn more readily and completely than those of sweet cream under like conditions, especially in the case of cream raised by gravity. The lactic acid coagulates the casein and thus greatly decreases the strong influence it has in its usual condition to keep the fat-globules from coming into contact with one another.

(4.) Temperature Used in Churning.—The condition that exercises most influence upon the ease with which the fat-globules unite in churning is the temperature of the cream. This determines, more than any other factor connected with churning, the hardness or softness of the fat-globules. When the temperature is too low, the fat-globules are so hard that they do not stick together when they come into contact, and, consequently, no butter results. When the temperature is too high, the agitation of the fat-globules in churning tends to break them up into smaller globules rather than to unite them into larger masses, thus forming a more complete emulsion, more difficult to churn than the original cream. Fat-globules may be made to unite at temperatures as low as 46 degrees F., and as high as 80 degrees F. Thus, the range of possible churning temperatures is very considerable, but the quality of butter produced at different temperatures is very different, particularly in texture. The butter is in the most satisfactory condition at the end of churning, when the temperature of the cream during churning has been such that the fat-globules have united readily into firm, solid granules of butter, with a minimum content of buttermilk. No particular temperature can be prescribed for churning, as other conditions enter in to modify the temperature of churning, such as (a) the individuality of cows, (b) the stage of the lactation period, (c) the character of the food eaten by the cows, (d) the season of the year, (e) the thickness of the cream, and (f) the degree of its ripeness. The conditions mentioned that are immediately connected with the cow, influence the composition of the milk-fat, making it harder or softer, as stated above. The harder the milk-fat, the higher the temperature at which churning should be done, and the softer the milk-fat, the lower the proper churning temperature. In the case of cream from the milk of cows far along in lactation, or of cows fed exclusively on dry feed or with considerable cottonseed meal in the ration, the churning temperature usually needs to be higher. In the case of cream from the milk of cows in the earlier stages of lactation, or of cows fed on succulent foods or foods rich in starch or sugar, the churning temperature should be lower. Generally speaking, a lower churning temperature should be used in summer and a higher one in winter. The richer cream is in fat, the lower the temperature that can be used successfully in churning, and the poorer the cream is in fat, the higher should be the temperature of churning, all temperatures, of course, being within the limits required for making butter of good quality. For example, cream containing 15 per cent. of fat may be churned at 58 degrees F. to 62 degrees F.; cream containing 40 per cent. of fat may be churned at 50 degrees F. Lower temperatures remove the fat most completely. Ripened cream can be satisfactorily churned through a greater range of temperature than sweet cream can, especially in the case of cream raised by gravity. From the foregoing statements, it can readily be seen that no fixed temperature can be given as the correct one at which cream in general should be churned.

(5.) Kind of Churn.—Different churns are made so as to give each a different kind of motion to the cream in churning. Thus, we have (a) churns with a beating action, (b) swinging, cradle and rocking churns, (c) horizontal churns with dash, (d) vertical churns with dash, end (e) churns with a variety of special contrivances for stirring the cream. On the whole, experience appears to show that the best churns are simple barrel or box churns, entirely hollow, without special paddles or stirring apparatus inside. In such churns, the agitation of the cream is caused by the striking of the particles of cream upon the sides of the revolving churn rather than by a stirring motion. When paddles or other means of stirring are used in churning, it is believed that the texture of the butter is liable to be injured. The speed of churning should be such that the motion of the cream will stop just short of taking on the centrifugal motion of the churn. The object to be kept in view is that the particles of cream shall move about against one another most frequently and thus give the fat-globules the greatest chance to come into contact one with another.

34. When to Stop Churning.

Butter is said to "begin to come," or to "break" when the fat-globules have formed masses sufficiently large to be readily seen in the cream. From this point, the process of churning is soon completed. In finishing the operation of churning, two points should be aimed at, (1) completeness of churning and (2) retention of smallest practicable amount of buttermilk in butter granules.

(1.) Completeness of Churning.—By completeness of churning we mean the extent to which the fat has been gathered from the milk-serum into butter. This is shown by the amount of fat left in the buttermilk, and is governed by several conditions, which have already been mentioned. Thus, the loss of fat in buttermilk is greater in mixed creams of varying degrees of ripeness than it is in uniformly ripened cream; it is greater at higher temperatures of churning than at lower ones. As an indication of when the fat is removed as completely as practicable by churning, the size of the butter granules may be taken, though not always. The usual instructions given are to stop churning when the butter granules are about the size of kernels of wheat. This cannot always be relied upon as showing that the churning has been completed, since, under differing conditions, the completeness of separation differs with the size of butter granules. The appearance of the buttermilk is usually a good indication of the completeness of churning; when the fat has been most efficiently removed, the buttermilk should look bluish and thin or watery, an appearance not difficult to distinguish. As a rule, churning should be continued until the buttermilk reaches this condition, without reference to the size of the butter granules. When the churning is most effective, the buttermilk should not contain more than one-tenth of one per cent. of fat.

(2.) Amount of Buttermilk left in Butter.—The larger the granules of butter at the close of churning, the greater the amount of buttermilk remaining in the butter. This is an undesirable condition, since the keeping quality of butter is unfavorably affected by the presence of much buttermilk. Every effort should be made so to control the conditions of cream ripening and the conditions of churning that, when the butter granules are the size of wheat grains, the fat will be removed from the buttermilk as completely as is practicable.

35. Difficulties Experienced in Churning.

It is a common experience, especially in making butter at home, to have churnings in which the fat-globules separate in granules with extreme difficulty from the buttermilk, or refuse to separate at all. Various conditions may cause this behavior. Some of these have already been referred to in connection with the conditions of churning. To some of these we will call more detailed attention at this point, including (1) the influence of advance of lactation, (2) improper ripening of cream, (3) cream poor in fat, and (4) low temperature of churning.

(1.) Influence of Advanced Lactation.—In the case of cows that are far advanced in lactation, we find a combination of conditions that work against the ease of churning, such as small size of fat-globules, milk-fat of harder character than normal, and a larger amount than usual of albumin, casein and milk-sugar in the milk and cream, thus increasing the resistance offered to the uniting of the fat-globules. In the case of cows that come into milk in the spring, these conditions are noticeable in the winter, when, in addition, the food is often largely dry hay or straw. These conditions may also be aggravated by improper ripening of cream. To overcome the difficulties of churning caused by these conditions, the cows must be given succulent feed, such as silage or roots, and the cream must be ripened so as to develop more than the usual amount of acid. In extreme cases, some additional help may come from diluting the cream slightly with warm water or by adding dilute salt brine.

(2.) Improper Ripening of Cream.—The cream should be ripened under the conditions previously given (see sections 26 to 28, pp. 41-44).

(3.) Cream Poor in Fat.—Usually, it is more difficult to churn completely cream poor in fat. This condition needs to occur only when gravity methods are employed in raising cream. By using the centrifugal method of separating cream, no trouble need ever be experienced in this line.

(4.) Low Temperature in Churning.—In churning at very low temperatures, the agitation mixes air with the cream and the cream often froths or swells. Under these conditions, it is best to let the cream stand several hours and then to warm it up slowly four or five degrees, before trying to churn again. Revolving churns give less trouble in this respect than dash churns. Then, again, in churning at low temperatures, the formation of butter may stop just short of the "breaking" point and not be affected by further churning. In such cases, the difficulty may be overcome by adding a little dry salt to the cream or a little water of the temperature of 85 degrees F. to 90 degrees F.

36. Removing Buttermilk from Granules.

When the churning has been completed and the fat has been gathered into granules successfully, the next step is to remove the buttermilk from the butter. As previously stated, the butter at this stage should be in granules not larger than kernels of wheat, and the buttermilk should be clear and watery in appearance, if the cream has been properly ripened and the churning done at the right temperature. By the old way, the churning was continued until all the butter was gathered into a fairly solid chunk and was then removed from the churn and the buttermilk was removed by pressure at the same time the salt was worked into the butter. The usual method now is to stop the churn when the butter is still in the granular stage, add a little cold water to favor the separation of the smaller fat-globules still remaining in the buttermilk. The buttermilk is then drawn off from the bottom of the churn and allowed to drain completely, after which water having a temperature of 45 degrees F. to 55 degrees F. should be added in amounts about equal to two-thirds of the buttermilk removed. The water and butter granules in the churn are then greatly agitated, enabling the water to come into contact with every butter granule, care being taken to avoid an amount of motion that will cause the granules to mass in chunks. In about fifteen minutes, this water should be drawn off, the granules allowed to drain thoroughly, and then the operation of washing should be repeated a second time as before. The second wash water should appear clear as it runs away, or, at most, have only a very slight milkiness. If the churning operation has been properly conducted, two washings should suffice to remove the buttermilk. The less washing that is necessary to remove the buttermilk the better. A small amount of salt added to the first wash water aids in removing the buttermilk without salting the butter appreciably. The texture of the butter and the amount of water in it are affected by the manner in which the washing is done, and by the condition of the butter granules.

(1.) Influence of Washing upon Percentage of Water in Butter.—When the butter granules are small and the wash water very cold, more water remains in the butter without appearing in the form of distinct drops than is the case when the granules are larger and the water less cold. If the end of the churning leaves the butter in chunks of the size of a small plum or larger, it is impossible completely to wash the buttermilk out of the butter, and especially if the butter is soft. In such a case, the buttermilk must be removed by working, but can not be done completely even then, and the butter will have a high water content.

(2.) Influence of Washing on Texture of Butter.—The temperature of the water used in washing butter affects the texture of the butter. When butter is soft at the end of churning, and it is hardened by being rapidly cooled down by the addition of large amounts of very cold water, the texture is likely to show the effect of the rapid change of temperature. When thus treated, the outside of the butter granules cools some time before the inside, and if time is not given for complete cooling before it is worked, we have a part of the butter still soft. In case the butter granules are soft at the end of churning, as the result of too high temperature in churning, the proper method of procedure is to use the usual amount of water at the usual temperature and allow the butter to remain in it, until it has become thoroughly cooled clear through. If treated in this way, it can be worked without risk of getting soft again at once. In addition, the use of large amounts of water in washing butter is apt to remove some of the compounds that give the butter its flavor, producing a flavorless or tallow-like tasting butter.

37. Working Butter.

The real objects in working butter are (1) to mix the salt with the butter and (2) to get the butter into a solid mass suitable for market. Working butter more than is necessary to accomplish these two purposes is not only useless but may be worse than useless when carried to such an extent as to injure the texture or grain of the butter. There is least danger of injuring the grain of butter, when the working is done by pressure, at a temperature of 45 degrees F. to 55 degrees F. The mistake should be avoided of depending upon working to remove moisture, since this is controlled by the size of the butter granules and the temperature of churning. Fine granules and low temperature favor assimilation of moisture.

38. Salting Butter.

The specific purpose for which salt is added to butter is to give taste. The small amount of salt present in butter has little to do with the keeping properties, as only larger amounts of salt have marked antiseptic effect. The one guide upon which to depend as to how much salt shall be added to butter must be the special market in which the butter is sold, in other words, the taste of the consumer. In actual practice, the amount of salt varies all the way from a trace to two and one-half ounces for each pound of butter. The amount of salt preferred by most consumers is three-fourths of an ounce to one ounce of salt for a pound of butter. In some creameries, butter is made for several different markets, requiring all kinds of salting and extreme pains have to be taken to have each kind always uniform. In order to turn out butter of the same uniform quality from day to day, it is essential that the amount of salt retained in the butter shall be the same, or with the least variation possible. It would seem to be a simple matter to control the amount of salt in butter by weighing the drained butter and salting this in proportion to its weight. But the drained butter is not of constant composition from day to day, because the size of the butter granules and the amount of water clinging to them are not uniform and, hence, the weight of the washed, drained butter granules does not bear a constant, definite relation to the amount of butter when finished. The larger the amount of water in the butter granules, the larger is the amount that will go out on salting and working, and the less will be the amount of salt left in. When the creaming is done by a separator, and a cream of uniform composition is used from day to day, the weight of cream affords a better basis for calculating the amount of salt to use than does the weight of washed butter granules. The salt can be incorporated easily and evenly into the whole mass of butter, if it is added while the water is being pressed from the butter in the worker. It is important to continue the working until the salt completely dissolves, because undissolved particles of salt may cause mottled or streaked butter. A particle of solid salt remaining in the butter may later dissolve in the water contained in the butter and thus form a strong brine at that point, which tends to deepen the color of the butter that comes in contact with this drop of strong brine. Care should be used in the selection of dairy salt, as different brands of salt vary in their fitness for use in salting butter. Generally speaking, good dairy salt should have a uniform size of particles, should be dry and should completely dissolve to a clear solution.

When a small amount of salt is desired in butter, it can be more uniformly and completely incorporated into the butter by using brine instead of dry salt. For this purpose, a brine is prepared by dissolving in warm water all the salt that can be made to dissolve. This brine is cooled to the proper temperature and poured over the butter. The brine may take the place of the second wash water and allowed to stay with the butter about ten minutes, when it is drawn off and a second portion of saturated brine added to the butter for the same length of time. Then the brine is removed and the working done in the usual manner.

39. Packing Butter for Market.

Butter is in condition to pack for market when the salt entirely in solution has been completely and uniformly worked through the butter, and the water in the butter reduced to the desired amount. When butter is to be kept for some time before marketing, it should contain less water than butter intended for immediate use. Popular taste at present appears to call for a comparatively large amount of water in butter when it is consumed fresh. A large amount of water in butter that is to be kept awhile before consumption is objectionable, because sooner or later the water evaporates from the surface, leaving a coating of salt, and the appearance is injuriously affected.

The problem of a perfect butter package yet remains to be solved; that is, a package which is strong, light in weight and air-tight. Packages made of crockery, glass or metal are heavy and liable to be broken. Tin and iron packages rust easily in the presence of the brine. Wooden packages are seldom air-tight. It appears to be the general impression that wooden packages are in all respects the most available. The materials most commonly used are probably ash, spruce and oak. Wooden packages are subject to the disadvantage of imparting their flavor to butter when it is kept in them long. Therefore, great pains must be taken to remove the odor of wooden packages as far as possible before they are used. This may be done by steaming the packages thoroughly and then filling them with hot water, containing some salt. After standing twenty-four hours they are steamed a second time and then filled with cold water.

For direct consumption, butter may advantageously be packed in moulds or prints. The popular demand for this style of package has increased greatly within a few years and its popularity appears to become greater all the while. Prints in pound and half-pound sizes are found in every grocery. The standard size for pound prints is $4\frac{5}{8}$ by $2\frac{1}{2}$ by $2\frac{3}{8}$ inches, and the shape is rectangular. Each print is wrapped separately in parchment paper and special packing boxes are furnished for carrying them.

40. Qualities of Butter.

Certain points have been adopted by common consent to use as a basis or standard in judging of the value of butter. The qualities that have been selected for this purpose are, (1) flavor, (2) texture, (3) color, (4) salt and (5) general appearance. To these may be added (6) moisture and (7) solidity.

(1.) Flavor.—Butter is said to have a good flavor when it possesses the characteristic taste and odor of good butter in a well-marked degree. It is difficult to describe in words what this flavor is, but it is commonly described as a nutty flavor, clean, aromatic and sweet. It should be entirely free from any rancidity or any other unusual flavor. Personal preference forms a very large factor in judging the value of butter in so far as it depends upon flavor. High flavor, for some persons, means sour milk or buttermilk flavor, while, for others, such a flavor must be absent. The real flavor of high-grade butter can be produced only under most favorable conditions of manufacture. Every operation must be conducted with care, and extreme pains must be observed at all times in respect to cleanliness. The one step in the operation of butter-making that has most influence directly upon the flavor of butter is the ripening of the cream, and too great care can not be taken to have perfect control of this delicate process. Food also exercises some influence. The flavors that are objectionable in butter may come from food, from the absorption of bad odors by the milk or cream, from the action of undesirable forms of bacteria and from excessive amounts of buttermilk retained in the butter.

(2.) Texture.—The texture of butter refers to what is called the grain and depends upon the condition of the butter granules. In its first formation in churning, butter appears in very small, irregular grains or granules. These grains retain their individuality throughout the rest of the process of butter-making and even in the finished product. The more distinct we can keep the individuality of the granules and at the same time make the butter into solid masses, the better is the texture. The granular texture of butter is seen when a mass of butter is broken into parts transversely, giving somewhat the fractured appearance seen in broken cast iron and free from a greasy appearance. Another method of testing the texture is to pass a knife blade or a butter trier through the butter; when it is withdrawn, no particles of butter stick to it. The texture of butter is injured by allowing the butter granules in the churn to become too large, and by working at too high a temperature or too much. The granular texture of butter is entirely and permanently destroyed by warming butter up near to the melting point.

3. Color.—The standard of color for butter is the color given when the butter is made from the milk of a cow feeding upon fresh pasture grass—an even, bright, golden yellow. Just what substance it is that gives butter its natural color, we do not know yet, but we do know some of the conditions that influence its color, such as the breed of cow, character of food and stage of lactation period. Butter tends to become lighter in color toward the end of a cow's lactation period, and especially if the cow at that time is fed exclusively upon dry foods. On fresh pasture, some cows produce butter somewhat too high in color for the critical consumer. Most butter in commerce is artificially colored. There is quite a number of different butter-color preparations in the market, some of which are aniline compounds and are poisonous when used in considerable quantities. If a butter-color is used, it is wise to use annatto or other preparations, which are known to be harmless. When butter is artifically colored, the colored product should be uniform, of a bright, golden-yellow color, free from any reddish tinge. Different shades of color are called for by different markets.

(4.) Salt.—The main point in connection with salt in butter as affecting quality, is that the salt should be entirely dissolved and distributed uniformly throughout the entire mass of butter. As to the amount of salt in butter, this must be judged entirely according to the standard of the special trade for which it is made.

(5.) General Appearance.—Under this head we include the attractiveness of the package and packing, cleanliness, etc.

(6.) Moisture.—The water should be so completely incorporated with the butter that it fails to show its presence, not appearing in the form of free beads of water.

(7.) Solidity.—By this is meant the quality of firmness or hardness, not melting or softening too easily.

The different qualities indicated above are used in a specific manner for determining the market value of butter, each quality having assigned to it a definite numerical value. The following so-called scale of points is in common use in the markets of this country:

Flavor, 40 to 45.
Texture, 25 to 30.
Color, 10 to 15.
Salt, 10.
Appearance, 5.

41. Composition of Buttermilk.

Buttermilk is the product, containing water and milk solids that remains when fat is removed from milk or cream in the process of butter-making. In general composition, buttermilk resembles skim-milk, containing, like skim-milk, all the constituents of milk, but in different proportions. The amount of fat in buttermilk is of the greatest importance in connection with churning, for only by knowing the amount of fat in buttermilk can we tell with certainty how complete the churning is. So, the buttermilk should always be tested in order to know whether large amounts of fat are being needlessly wasted by being left in the buttermilk. We have already discussed the conditions that affect the amount of fat left in buttermilk, in sections 33 and 34. If the conditions of butter-making are properly controlled, there need not be left in the buttermilk more than one-tenth of one per cent. of fat. Buttermilk from ripened cream differs from that obtained with sweet cream, the former containing less milk sugar, more lactic acid and less milk-fat. The following analysis will serve as an illustration to give a general idea of the composition of buttermilk obtained under the best conditions:

	Per cent.
Water,	90.60
Fat,	0.10
Casein and albumin,	3.60
Milk sugar,	4.40
Ash,	0.70
Lactic acid,	0.60

CHAPTER VI.

THE RELATION OF MILK TO YIELD OF BUTTER.

If we compare the composition of milk with that of butter, we are impressed with the fact that a very small amount of the solids contained in milk, excepting milk-fat, goes into butter. Below we give an illustration showing, under the conditions stated, the distribution of milk-fat through the various operations of butter-making.

42. Distribution of Milk-Fat in Butter-Making.

In the accompanying illustration we assume that we start with 1,000 pounds of milk, containing 4 per cent. of fat; that we produce, in creaming, 200 pounds of cream and 800 pounds of skim-milk, containing 0.10 per cent. of fat; that in churning we produce 155 pounds of buttermilk, containing 0.20 per cent. of fat, and 45 pounds of butter. We will assume also that the mechanical losses of fat amount to 0.30 pound of fat. The following tabular arrangement brings out the manner in which the milk-fat is distributed through these various operations:

	Per cent. of fat in milk.
1,000 pounds of whole-milk contain 40.0 pounds of fat,	100.00
200 pounds of cream contain 39.2 pounds of fat,	98.00
800 pounds of skim-milk contain 0.8 pounds of fat,	2.00
155 pounds of buttermilk contain 0.3 pounds of fat,	0.75
45 pounds of butter contain 38.6 pounds of fat,	96.50
Mechanical losses of fat in various operations, 0.3 pounds of fat,	0.75

Of the amount of fat contained in the whole milk at the start, 98 per cent. went into the cream and 2 per cent. into the skim-milk, 0.75 per cent. into the buttermilk and the same amount was lost mechanically, while 96.5 per cent. went into butter. The total percentage of loss was 3.5 per cent. of the fat originally in the milk.

43. Relation of Fat in Milk to Yield of Butter.

We have seen that it is not milk-serum that produces butter, but it is milk-fat. Hence, if we wish to know the butter-making value of milk, we must know the amount of fat in milk and then we can tell very closely how much butter should be made from 100 pounds of any particular milk. Now, the question arises: "How much butter should be made for each pound of fat present in milk?" Taking the illustration given in the preceding paragraph, we have 1,000 pounds of milk containing 4 per cent. of fat, or 40 pounds of milk-fat, and from these 40 pounds of milk-fat we obtain 45 pounds of butter; that is, for each pound of fat in milk, we make one and one-eighth pounds of butter, or just one pound and two ounces. In this case, we made allowances for losses of fat in skim-milk, buttermilk and handling, which ought not to be exceeded in practice, when the different operations are carried on with proper skill and care. In general, we may lay this down as a fair rule to follow: Each pound of fat in milk should make one pound and two ounces of finished butter.

The question may next be asked, "Why do we have two ounces more of butter than we do of butter-fat or milk-fat?" While we lose a little fat in the operation of butter-making, we add to the milk-fat considerable water and some salt and retain a little casein, so that we not only make up for the fat lost but really add more than enough water, etc., to make up the loss. In the illustration above given, we had 40 pounds of milk-fat to start with, we lost 1.4 pounds in various ways in making butter, leaving for the butter 38.6 pounds of fat, and to this amount of fat we added 6.4 pounds of water, salt, etc., and thus obtained 45 pounds of finished butter. From the foregoing considerations, it can be seen that we need only to know the per cent. of fat in milk in order to calculate the amount of butter to be made from 100 pounds of the milk. It is necessarly only to multiply the per cent. of fat in milk by one and one-eighth or by one pound and two ounces. Thus, we could readily make up a table like the following, covering any range desired:

Per cent. of Fat in Milk.	Pounds of Butter that Should Be Made from 100 Pounds of Milk.
3,	3.37 pounds, or 3 pounds, 6 ounces.
3.2,	3.63 pounds, or 3 pounds, 10 ounces.
3.5,	3.93 pounds, or 3 pounds, 15 ounces.
3.8,	4.27 pounds, or 3 pounds, 4 ounces.
4.0,	4.50 pounds, or 4 pounds, 8 ounces.
4.5,	5.06 pounds, or 5 pounds, 1 ounce.
5.0,	5.62 pounds, or 5 pounds, 10 ounces.

44. How to Detect Losses by Yields of Butter.

Ordinarily, one can detect losses of fat in skim-milk and buttermilk by testing them for their fat content. In the absence of such tests, one can make use of the above rule to ascertain how effective one's work is in getting milk-fat into butter. For illustration, suppose we make butter from milk containing 4 per cent. of fat, and get 4 pounds and 3 ounces of butter. From the rule given above, we should get not less than 4 pounds and 8 ounces of butter, so that we have experienced a loss of 5 ounces of butter for 100 pounds of milk. We have either lost extra amounts of fat or we have failed to retain the usual amount of moisture in the butter or have experienced losses in both of these directions. An experience of this kind should move one to discern the causes of loss and then remedy them. In case the amount of butter is greater than is called for by the rule, then we have incorporated an extra large amount of water in the butter.

45. Milk-Fat as a Basis of Paying for Milk at Creameries.

Until a dozen years ago, milk was very generally paid for by weight alone at creameries. This method was based upon the belief that it was milk that made butter and that all kinds of milk were of equal value, pound for pound, in making butter. The next step in the direction of progress was to pay according to the amount of cream raised, measuring it by volume. This was a partial recognition that different milks varied in their butter-producing value. The method of paying for cream was extremely faulty, because the basis of payment was for so many spaces or inches of cream raised in a can of certain depth and diameter. This method assumed that all cream raised by the gravity system contained the same amount of fat and was, therefore, of equal value for making butter. Investigation showed that this assumption was wholly without foundation and was extremely misleading. The next plan put into practice was what was known as the "oil test," by which an attempt was made to measure the butter-producing values of different creams by actually churning small portions of cream. This plan was found to be open to several objections. Finally, the discovery of the Babcock test, in 1890, furnished a simple means of determining fat in milk or cream. From that time on, the method of paying for milk and cream at creameries on the basis of the fat content gradually spread until now it is probably univesal. The relation of fat in milk to yield of butter is so obvious that only persons lacking in average understanding can fail to appreciate the significance of such relation.

46. Calculating Dividends at Creameries on Basis of Milk-Fat.

Several different methods may be employed to determine the amount of each patron's dividend, when payment is made on the basis of the amount of fat in the milk. There are calculators published that save most of the details in making calculations. Here we present one of the simplest methods, showing all the necessary details. It is essentially the same as the old method in use when the weight of milk alone was used as the basis for payment, while, on the milk-fat basis, it is the amount of fat that is used in making calculations. We will illustrate this method as employed (1) in co-operative creameries and (2) in creameries where milk is purchased for a definite price.

(1.) In Co-operative Creameries.—Taking the time covered by any one dividend, whether a week or month, it is necessary to know (a) the amount of milk delivered by each patron during that time; (b) the per cent. of fat in the milk during the same period of time; (c) the total or gross amount of money received for the butter produced during the same period; and (d) the amount of expenses to be deducted from the gross receipts, such as cost of manufacture, selling, carting, etc. Having these data, we need only to apply the following rule, which is given, for convenience, in three steps.

Rule. Step 1. To find the amount of milk-fat furnished by each patron: Multiply together the per cent. of fat in the milk and the amount of milk delivered by each patron expressed in hundreds of pounds, and decimals of a hundred. This gives the total amount of fat in the milk delivered by each patron during the dividend period Example:

Name of Patron.	Pounds of milk delivered during dividend period.	Pounds of milk delivered by each patron, expressed in hundreds and decimals.	Per cent. of fat in milk during dividend period.	Pounds af fat in milk delivered by each patron.
A, ...	350	3.50×	4.0=	14.00
B, ...	650	6.50×	3.6=	23.40
C, ...	835	8.35×	5.2=	43.42
D, ...	965	9.65×	4.4=	42.46
E, ...	1,200	12.00×	4.2=	50.40
Total number of pounds of fat delivered by all patrons,	....	....	....	=173.68

Rule. Step 2. To find the net value of one pound of milk-fat: Divide the total net receipts by the total number of pounds of milk-fat delivered by all the patrons during the dividend period. Example:

From the amount of milk delivered by the patrons, as given above, we have made, say, 195 pounds of butter, which realizes 18 cents a pounds, after deducting the cost of making and all other expenses. This will give $35.10 to distribute among the patrons. We now divide $35.10 by 173.68, the total amount of milk-fat delivered by all patrons during the dividend period, and we have 20.2 cents as the net amount of money received from butter for each pound of milk-fat delivered.

Rule. Step 3. To find the amount of dividend due each patron: Multiply together the number representing the pounds of milk-fat furnished by each patron and the net price received for each pound of milk-fat.

In this case, the net price realized for each pound of milk-fat is 20.2 cents, and so we multiply by this the number of pounds of fat delivered by each patron. Example:

Name of Patron.	Pounds of fat in milk delivered.	Net price received for each pound of fat (cents).	Amount of money received by each patron.
A,	14.00×	20.2=	$2 83
B,	23.40×	20.2=	4 73
C,	43.42×	20.2=	8 77
D,	42.46×	20.2=	8 58
E,	50.40×	20.2=	10 18

(2.) In Creameries Where Milk is Purchased.—Under this division come those cases where patrons sell their milk outright for such a price as may be agreed upon. In such cases, a standard may be adopted and milk paid for according to this standard. For example, suppose the proprietor of a creamery agrees to pay at the rate of one dollar a hundred for milk containing 4 per cent. of fat, the price being greater or less than this in proportion as the per cent. of fat is above or below 4 per cent. Paying one dollar for 100 pounds of milk containing 4 per cent. of fat is equivalent to paying 25 cents a pound for milk-fat. Applying this rate to the illustration given above, we have the following:

Name of Patron.	Pounds of fat in milk delivered.	Net price received for each pound of fat (cents).	Amount of money received by each patron.
A,	14.00×	25=	$3 50
B,	23.40×	25=	5 85
C,	43.42×	25=	10 85
D,	42.46×	25=	10 62
E,	50.40×	25=	12 60

CHAPTER VII.

PRELIMINARIES OF CHEESE-MAKING.

As compared with butter-making, the process of cheese-making is much more complicated in its details and difficult to control. It is probably true that our best methods of butter-making are much nearer perfection than are our best methods of cheese-making, but many improvements have taken place in the details of the process of cheese-making during the past twelve or fifteen years. Before the actual operation of cheese-making begins, there are several details which can properly be considered in a separate chapter. We shall, therefore, discuss in this chapter (1) the care of milk by the dairyman for cheese-making, (2) the method of testing milk to detect injurious forms of fermentations, (3) the action of rennet in cheese-making, and (4) the ripening of milk for cheese-making.

47. Care of Milk for Cheese-Making.

In section 13, p. 28, we discussed in considerable detail the precautions to be observed in securing clean milk when the milk is to be sold for direct consumption. All the precautions given there in regard to the conditions of cleanliness to be observed apply with equal force to milk that is to be used for cheese-making. However, in the case of milk intended for cheese-making, after it has been drawn, removed from the stable and strained, we do not need to be so careful in keeping the lactic acid bacteria from growing as we do with milk to be sold for direct consumption. While most of the undesirable forms of fermentation, commonly occurring in milk, may work injury in cheese-making, it is, so far as we now know, very necessary to have more or less lactic acid fermentation in the milk and curd during the cheese-making process, in order to make good cheese, especially in the case of our common type of cheese, the American cheddar. There are two additional points to which special attention will now be called in caring for milk for cheese-making and these are (1) cooling and (2) aerating.

(1.) Cooling Milk.—It is desirable to cool the milk down to the temperature of the surrounding air, or, still better, to 60 degrees F., if it has to be kept long. It is a good plan to assist the cooling by constant stirring. Two objects are thus accomplished. In the first place, in milk thus treated the fat tends to cream less rapidly.

a desirable condition, because in the cheese-making process we want to prevent the separation of the fat from the milk as much as possible. In the second place, the stirring helps any substances with odors to escape from the milk, especially the so-called animal odor and any others that may have been absorbed from the air.

(2.) Aerating Milk.—Stirring milk while cooling is one method of exposing it to the air, that is, aerating the milk. The aerating, as well as the cooling, can be advantageously accomplished by using special forms of apparatus designed for the purpose. The most common form of aerator is a strainer-like tin vessel with holes in the bottom. It is held in position somewhat elevated above the milk can by an iron frame. The milk, as soon as drawn, is strained into this at once and the milk falls in finely-divided drops or streams through the air before going into the can. The Star cooler and aerator allows the milk to flow in a thin film over a corrugated metal surface; the cooling is caused at the same time by having cold water flow through the apparatus. While the more common practice is to cool and aerate only night's milk, it is desirable that morning's milk should be similarly treated. It is also desirable that the two milkings should be kept separate and not taken to the factory in the same can, unless the morning's milk is cooled to the temperature of the night's milk before mixing.

As soon as milk has been cooled and aerated, it should be covered, in order to prevent evaporation from the cream layer. If much evaporation takes place, the layer of cream becomes somewhat tough and does not mix back readily into the milk. This is objectionable for two reasons, (a) the loss of fat is apt to be larger in cheese-making, and (b) it is more difficult to obtain a representative sample for testing. This difficulty usually occurs only with night's milk, but can very easily be obviated.

48. Detection of Injurious Ferments in Milk.

It is extremely important at times to find out whether milk is fit for cheese-making, especially, where troubles have been experienced with fermentations that make it difficult or impossible to produce good cheese. At the Wisconsin Experiment Station a simple method known as the "Wisconsin curd test," has been devised for detecting milks that are undesirable for cheese-making. Specially designed apparatus can be obtained at dairy-supply houses, but is not necessary. The test consists in making a small chunk of cheese-curd from milk in a glass jar. Take pint fruit-jars and perforate the covers with a few small holes. Before using, clean them in boiling water. A sample of each of the milks to be tested is placed in a jar, nearly filling the jar, and the jar is placed in water warmed to about 95 degrees F. to 100 degrees F. Then ten drops of rennet extract are added to the milk in each jar and the contents are thoroughly mixed. The milk is then left undisturbed until completely curdled, after which it is cut in small pieces with a case knife and stirred in order to expel the whey. Care must be taken to clean the knife each time before cutting the curd in each jar. The whey is poured off at frequent intervals, until the curd mats. The curd is then kept at a temperature of about 98 degrees F. for six or eight hours and then examined. If the milk is good, the curd from it has a solid, firm texture, with only a few small pin-holes, if any. It may have some large, irregular holes caused mechanically by the failure of the particles of curd to unite closely. If gas-forming bacteria are present in the milk, they will produce a curd of spongy texture, very full of holes. Other undesirable fermentations may show their presence by producing a curd of soft, "mushy" texture, while others develop offensive odors. By the use of this test, it is easily possible to detect what patron's milk is the source of trouble, or, in the case of a herd, what individual cow or cows. When unfavorable fermentations are met with in factory experience, this test should be promptly and thoroughly applied, and milk found to be responsible for the trouble should be excluded until its character is improved. Also, milk should not be received for cheese-making when it contains as much as two-tenths of one per cent. of lactic acid. This curd test may also be applied to the examination of market milk that is sold for direct consumption.

49. Source and Properties of Rennet Extract.

We have already (see section 9, p. 22) referred to rennet as containing an enzyme or unorganized ferment, called rennet, which possesses the characteristic property of coagulating or solidifying milk-casein, and, on this account, lies at the basis of our cheese-making. Rennet is used in the form of an extract.

(1.) Source of Rennet Extract.—The usual source of rennet is the fourth stomach of a calf that has not stopped living upon milk. The enzyme is separated from this by special tratment, such as soaking in dilute salt water. For cheese-making purposes, it is much preferable to purchase one of the regular commercial rennet extracts rather than to use a home-prepared article. The best brands of commercial extracts are uniform in strength and free from taints, and this is not commonly true of home-prepared extracts. Rennet extract should be kept in a cool, dark place, if it is to keep its strength for the longest possible time.

(2.) Strength of Rennet in Coagulating Milk.—How powerful the action of rennet is in cogulating milk-casein can be seen in cheesemaking ,where we use only one part of rennet extract to five thousand parts of milk, and rennet extract itself is only a dilute form of rennin, the real coagulating substance. One part of absolutely pure rennin can coagulate three million parts of milk. Apparently, rennet extract does not exhaust itself by its own action, but can be used repeatedly. For example, if we could recover from whey and curd the rennet used in coagulating milk, it would coagulate an equal quantity of milk again.

(3.) Chemical Action of Rennet.—When rennet acts upon milk-casein, it changes the composition of the casein, forming a new compound, and this new compound which appears as the coagulated substance is called paracasein. Cheese curd is, then, an impure form of paracasein. This paracasein formed by rennet is quite different from the solid substance formed by milk casein when treated with acids.

(4.) Conditions of Rennet Action.—The conditions of rennet action are quite well understood and we will consider some of them. The rapidity and completeness of coagulation of milk casein by rennet are dependent upon the following conditions:

(a.) Acids Affect Action of Rennet.—Milk must be neutral or acid for action of rennet. If milk is alkaline, rennet will not coagulate it. Increased amounts of acids have a very marked effect in increasing the rapidity and completeness of rennet action in coagulating milk casein. Moreover, very small amounts of acid have a very pronounced influence. For example, a sample of fresh milk that coagulated in 110 seconds was coagulated in 30 seconds when one part of lactic acid was added to 5,000 parts of milk.

(b.) Temperature affects time of coagulation by rennet. The quickness with which rennet coagulates milk increases with increase of temperature. For example, a sample of milk that coagulated at 75 degrees F. in 270 seconds, was coagulated in 65 seconds at 95 degrees F. The character of the coagulated substance also varies with the temperature at which coagulation takes place. Below 60 degrees F. and above 122 degrees F., the curd formed is soft and loose, while at 77 degrees F. to 113 degrees F., the curd is much more firm and solid. The activity or strength of rennet is weakened by heat at 120 degrees F., while heated for sometime above 140 degrees F., rennet becomes permanently weaker or entirely inactive.

(c.) Strength of rennet extract increases rapidity and completeness of rennet action, likewise increased amounts of rennet extract. Dilution of milk by water has the effect of diluting rennet extract and so a given amount of rennet extract acts less rapidly and completely in diluted milk than in the same quantity of milk undiluted.

(d.) Different chemical compounds added to milk affect the action of rennet. For example, many acid salts like free acids, hasten rennet action. Alkaline and alkaline salts prevent it. Rennet coagulation is delayed by common salt, borax, formalin and some other substances used in milk preservatives.

(e.) Heating milk above 150 degrees F. for some time makes it coagulate less quickly with rennet than unheated milk. Milk heated to boiling for some time coagulates either very slowly and incompletely or not at all with rennet. The coagulating power of such milks may be restored by adding small amounts of some acid or by adding calcium chloride.

(f.) Milk from different cows behaves very differently to rennet. For example, in some tests made at the same time and under the same condition with samples of milk obtained from fifteen different cows, the time of coagulation by rennet varied in the individual samples all the way from 50 seconds to 23 minutes. Just why such differences exist no one knows.

50. Methods of Testing Rennet Extracts.

Since different brands of rennet extract vary somewhat in their ability to coagulate milk, it is important to have a means of testing their strength, so that we may know definitely their value. The strength of a rennet extract may be ascertained by finding out how long it takes for a certain amount of extract to coagulate a fixed amount of milk at some definite temperature. The two or three rennet tests in use are based upon this general principle. The two forms in common use are known under the names of (1) the Monrad test and (2) the Marschall test.

(1.) The Monrad Rennet Test.—In this test the amount of milk used is 160 cubic centimeters (about five and one-half ounces fluid measure), and the temperature is 82 degrees to 86 degrees F., and the amount of rennet is one-half of a cubic centimeter, which is diluted to 5 c. c. with water. The apparatus furnished for this test by dairy-supply houses makes these measurements simple. Having the rennet previously diluted, one makes the test as follows: The given amount of milk is heated to 82 degrees to 86 degrees F., 5 c. c. of the dilute rennet solution are added and stirred in quickly with the thermometer. A fixed temperature must be used always; it can be any one point from 82 degrees F. to 86 degrees F., but the point must always be the same one. The time when the rennet is added is noted by the second hand of the watch and then again the time when the milk has coagulated, and then we know how many seconds it has taken for the milk to coagulate. The time when the milk coagulates can be seen more sharply by scattering a few particles of charcoal on the surface of the milk. The milk is started into motion around the dish by stirring with the thermometer, and the charcoal particles stop the instant the milk curdles. By using a stop watch in carrying out this test, great accuracy and delicacy can be attained. In comparing two rennet extracts by this test, the one that coagulates the milk in the quickest time is the strongest. If possible, the same kind of milk must be used in comparing different extracts. (See Fig. 3.)

(2.) The Marschall Rennet Test.—In this test, the same general plan is followed, but the coagulation takes places in a cup on the sides of which are some graduated lines, while in the bottom of the cup is a glass tube, with very small bore. After the rennet is added to the milk in the cup, this fine glass tube is opened and the milk allowed to trickle away, until the milk coagulates and ceases to run. The marks on the inside of the cup show how much milk has run out and the number of spaces uncovered show the strength of the rennet. The stronger the action of the rennet, the more quickly is the milk coagulated and the less runs out and the fewer spaces are uncovered. There are some objections to this test, which should be noted. A difference in the bore of the glass tube in the bottom of the cup makes a great difference in results, and it is found that the bore differs in different cups. In trying different cups, always compare them on the same sample of milk. While the Marschall test is convenient for ordinary factory work, it is not capable of as great delicacy as is the Monrad test and, therefore, is not so well suited for work requiring extreme precision.

51. Ripening Milk for Cheese-Making.

In ripening milk for cheese-making, the aim is, as in the case of ripening cream, to encourage the fermentation of lactic acid, but in a lesser degree than in cream. Let us first consider how we ripen milk for cheese-making and then how we determine when we have ripened milk enough.

(1.) How to Ripen Milk.—Lactic acid may be formed in milk simply by heating the milk to 82 degrees F. to 86 degrees F., and allowing it to stand awhile. This temperature favors the rapid growth of the lactic acid bacteria already in the milk and the fermentation of the lactic acid takes place quite promptly in ordinary factory milk. There are times, however, when either lactic acid organisms are not abundant or other injurious forms of ferments are so abundant as to repress the growth of the acid-formers, and, under such conditions, it is unwise to wait for the development of the acid bacteria. The method is then to develop lactic acid by adding a starter. A starter prepared as described in section 27, p. 42, may be used, or

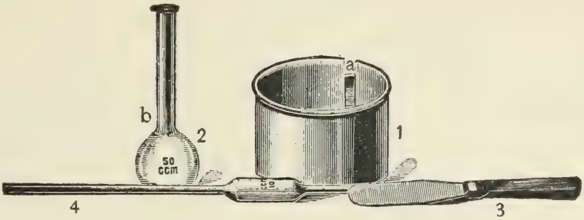

Fig. 3. Monrad's rennet test.

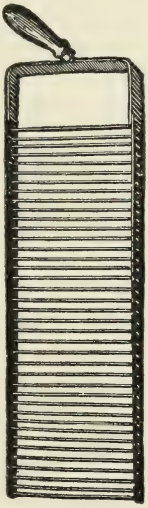

Fig. 4. Horizontal curd-knife.

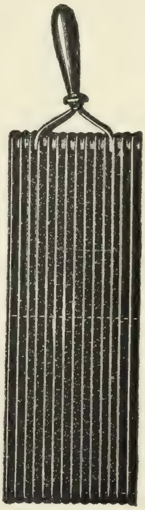

Fig. 5. Perpendicular curd-knife.

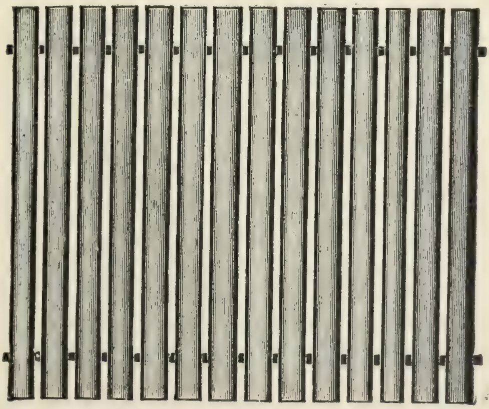

Fig. 6. Curtis improved curd-rack.

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Hansen's "Lactic Ferment" can be employed to advantage. The amount of starter to be used in ripening milk for cheese-making should be from two to five pounds of starter for each hundred pounds of milk. The amount will vary according to the temperature of the air and the degree of acidity already in the milk when it comes to the factory. Starters should not be prepared from the mixed milk in the vat or from whey.

(2.) How to Determine the Proper Degree of Ripeness.—Since ripeness in milk means formation of lactic acid, we can measure the ripeness of milk by determining the amount of lactic acid as in the case of cream, but for cheese-making purposes this method is not sufficiently delicate. It has been pointed out above that the activity of rennet is extremely sensitive to the presence of acid; a very minute amount of acid greatly increases the activity of the rennet and reduces the time in which it will coagulate milk. The most satisfactory test for ripeness in milk is to make use of the rennet test in one of the forms described in the preceding section. When milk is found to coagulate by the Monrad test in 45 to 60 seconds, or by the Marschall test in two and one-half spaces, enough acid has developed to enable one to add the rennet for coagulating the milk in the vats. The effect of ripening milk is to hasten the whole operation of cheese-making. The general aim is to have such an amount of acid formed when the rennet is added that the rest of the operation con be completed in six hours. Milk containing as much as two-tenths of one per cent. of lactic acid when brought to the factory is overripe and liable to make trouble in cheese-making. Overripe milk usually causes losses of extra amounts of fat and decreased yield of cheese, since it is difficult for the cheese-maker to control satisfactorily the different operations of cheese-making.

CHAPTER VIII.

MAKING CHEDDAR CHEESE.

There are two methods in use for making the kind of cheese most commonly found in our American markets, (1) the "stirred curd," or "granular" method, and (2) the cheddar method. The latter is probably more extensively used now. The product is essentially the same, though it is claimed for the cheddar system that the texture of the cheese is more solid, and the product more generally uniform, and with a somewhat smaller content of moisture. We shall describe only the cheddar method.

In the chapter preceding, we have prepared the milk for receiving the rennet. The remainder of the process can be advantageously described under the following divisions:

(1.) Coagulating the milk by rennet.
(2.) Cutting the curd.
(3.) Heating the curd.
(4.) Removing the whey.
(5.) Cheddaring the curd.
(6.) Milling the curd.
(7.) Salting and pressing curd.
(8.) Curing cheese.

The subject of cheese curing is so important that we shall reserve its discussion for another chapter.

52. Coagulating Milk by Rennet Extract.

This is also called among cheese-makers "setting the milk with rennet." It may be stated here, that during the process of ripening, the milk should be more or less constantly stirred, in order to mix back the cream that rises or rather to prevent its rising. The milk is heated gradually to 82 degrees F. to 86 degrees F., and then tested for ripeness. If sufficiently ripe the rennet is added at once; if not ripe enough, it is allowed to stand at the given temperature until it gives the right test. However, if the milk is so lacking in acid as to require too long for the acid to form without help, then use a starter as described above. When the amount of acid in the milk is reached according to the tests given above, the rennet extract should be added. Three points in this connection should be considered, (1) the temperature of the milk when the rennet is added, (2) the amount of rennet extract to be added to the milk, and (3) the method of adding the rennet extract.

(1.) Temperature of Milk when Rennet is Added.—There is a variation of a few degrees in the practice of different cheese-makers. The temperature at which the milk is ripened should be the temperature of the milk when the rennet extract is added, and that point may be anywhere from 82 degrees F. to 86 degrees F. The advantage of the higher temperature is more rapid action and economy of time, especially in ripening, if no starter is used. Milk coagulates more quickly considerably above 82 degrees F. to 86 degrees F., but this range of temperature has been shown by experience to be the most desirable. At higher temperatures the curd hardens too rapidly to allow one to cut it conveniently, and in the subsequent process there is greater liability to loss of fat.

(2.) Amount of Rennet Extract to Use.—The amount of rennet extract to use will depend chiefly on its strength, other things being equal, and this will have to be determined by the cheese-maker with each new lot of extract, employing the regular rennet test. The guide to keep in mind in determining how much rennet to use is this: Use enough rennet to curdle the milk in fifteen to twenty minutes for a quick-curing cheese, and, in thirty to forty minutes, for a slow-curing cheese. The rennet extracts in common use are added at he rate of two and one-half to five ounces for 1,000 pounds of milk, but generally at the rate of from three to four ounces.

(3.) Method of Adding Rennet Extract.—The rennet extract must be diluted with twenty to forty times its own volume of water, which may be cold or at a temperature of 85 degrees F. to 90 degrees F. The object of dilution is to prevent uneven action of rennet on the milk. If undiluted rennet extract is added to a vat of warm milk, the portions of the milk first coming in contact with the rennet coagulates at once before the rennet has a chance to reach the whole body of milk. The diluted extract acts much less quickly and gives one time to mix it uniformly and thoroughly, through the whole mass of milk. Some makers prefer to dilute the rennet with cold water instead of warm, on the ground that the cold water keeps the rennet inactive longer and thus gives a longer time in which to mix the rennet completely through the mass of milk.

Just previous to adding the rennet extract, the milk should be thoroughly stirred, and then the diluted rennet should be poured into the milk evenly from one end of the vat to the other. The milk is at once gently but thoroughly stirred again so as to mix the rennet completely and uniformly with it, and the gentle stirring is continued for several minutes. Then the surface of the milk is stirred quietly with the bottom of a dipper to keep the fat from separating, this movement being kept up for about half the time required to coagulate the milk but stopping before there is any appearance of coagulation. A cloth is then placed over the top of the vat, if necessary, to keep the surface of the milk from cooling, and the milk is kept undisturbed while the coagulation takes place. The rennet does not act instantaneously so as to show any visible signs, the first indication of acting being a slight thickening of the milk, shown by the slowness of drops of milk to fall from a thermometer or other object dipped in the milk and held up so as to allow the milk to drip from it. The coagulation goes on gradually until the whole mass of milk is one solid, continuous chunk of coagulum or curd, the result of changing milk casein into paracasein. In this process, the fat-golbules and also the other milk constituents are imprisoned in the paracasein.

53. Cutting the Curd.

The object of cutting the curd is to permit the whey to go out of the paracasein. This takes place much more rapidly and completely, in proportion as the pieces of curd are smaller. The paracasein, or curd, as soon as formed, shows a tendency to contract and this shrinking naturally forces out the whey, the liquid portion of the curd. In cutting, the extent of surface, from which the whey can go out, is enormously increased.

(1.) When to Cut Curd.—It is a point of some importance to know just when to cut the curd, as this has considerable influence upon the rest of the operation and upon the amount of fat lost and, so, upon the yield of cheese. If curd is cut when it is too soft, there will be large losses of fat and decreased yield of cheese. If the curd becomes too hard before cutting, the whey is removed less easily, and the quality of the cheese may be injured. The test used to determine when the curd is in the right condition to cut is the following: The end of the index finger is inserted obliquely into the curd half an inch or more and then slowly raised toward the surface; if the curd breaks apart with a clean fracture, without leaving small bits of curd on the finger, and the whey in the broken surface is clear and not milky, the curd is in the right condition of firmness to be cut.

(2.) How to Cut Curd.—In primitive methods of cheese-making, the curd was broken into small pieces with the fingers or with any kind of instrument, and no attention was given to having the small pieces of uniform size or shape. We now have specially devised knives for cutting curd, which leave the curd in small cubes about three-eighths of an inch in diameter. One curd knife is horizontal (see Fig. 4), with numerous parallel blades; the other is perpendicular (see Fig. 5). Cheese-makers differ in their practice in regard to which knife to use first, but it is a matter of little or no importance. In using the horizontal knife, it is carefully inserted into the curd at one end of the vat, care being taken not to jam the curd in so doing, and is then moved along from end to end until the whole mass has been cut. The perpendicular knife is then used at once, cutting not only from end to end of the vat but crosswise also. The movement of the knife should be somewhat more rapid toward the end of cutting. The object to be kept in mind in cutting is uniformity in size of pieces of curd after being cut. In the case of very ripe or over-ripe milk, the curd should be cut finer. The fineness is governed largely by the number of times the knives are passed through the curd.

54. Heating the Curd.

As soon as the curd is cut, the whey begins to go out of it and the curd settles to the bottom of the vat. If it remains undisturbed, the cut surfaces of the curd easily reunite and, when we break them apart, additional fat is lost. Therefore, as soon as the curd is cut, the whole mass is kept in gentle motion by careful hand-stirring or with a wire basket made for the purpose. Care must be taken to avoid any rough treatment that would crush or break the curd particles, the object of the agitation being simply to keep the particles of curd moving through the whey and thus preventing their settling and matting. Pains must be taken to keep the curd from settling in the corners of the vat or attaching itself to the sides, since, if left in such places, it will be heated too high later. The whey should appear clear and be fairly free from small particles of floating curd. The curd contracts and hardens during this stirring, but the shrinking takes place more quickly upon the outer surface of the curd particles than upon the inside. This hardening of the out surface prevents the curd particles from sticking together so readily, but offers some opposition to the further rapid escape of whey. In order to favor the continuous expulsion of whey, heat is used at this stage. The term "cooking" is commonly applied to this part of the operation, but the word is misleading, since we use only a gentle heat and in no sense "cook" the curd. The object of heating is to favor the contraction of the curd and the escape of whey. The cause of the shrinking of curd is probably due to union of lactic acid with the paracasein, forming a new compound which has the property of contracting. The heat favors the formation of this new substance, and the more rapidly it forms the more readily the curd shrinks and forces out the whey. Heat is applied gradually and the stirring is kept up constantly. Under normal conditions ,the heat is applied so as to raise the tempertaure of the curd and whey about one degree in five minutes, and rarely more than two degrees in five minutes. The heating should be somewhat slower up to 90 degrees F. than above that point, since the shrinking of curd takes place less rapidly below than above 90 degrees F. The contents of the vat should be heated finally to 98 degrees F. As the the temperature is increased, the curd particles become less tender, and toward the end of the heating they can be stirred much more vigorously without risk of injury. When the temperature of 98 degrees F. has been reached, the curd is allowed to settle to the bottom of the vat and remain quiet with only an occasional stirring, until a certain amount of acid has been formed or rather until a certain amount of the compound of lactic acid and paracasein has been formed.

55. Removing the Whey from the Curd.

The whey should be removed from the curd when a certain amount of lactic acid has combined with the curd (paracasein) or, as the cheese-maker commonly says, when there is "enough acid on the curd." How can we ascertain this? The behavior of the curd will give us this needed information. In the first place, the curd particles should be contracted to less than one-half their original size, and, in the second place, they should be so firm and rubber-like that when a mass of curd is pressed together between the hands and then suddenly freed from pressure, they should fall apart at once, and show no tendency to stick together. During the heating, the particles of curd should be examined occasionally to ascertain whether they are changing on the inside as well as outside. The third sign given by the curd is probably the most useful to go by in deciding when the curd has been heated long enough and when the whey should be removed, and that is what is known as the "hot-iron test." When a small mass of curd, which has been squeezed in the hand to remove whey, is pressed against a bar of iron, heated a little short of redness, and then carefully drawn away, fine, silky threads are formed, adhering to the iron. These strings are caused by the compound of lactic acid and paracasein and the more of this compound there is, the more the curd will string in length. So the hot-iron test is really a measure of the amount of acid that has been formed. Now, when the curd shows, by the hot-iron test, strings one-eighth of an inch long, the whey is drawn from the curd. The removal of the whey is sometimes called "dipping," or "drawing," the whey. When the development of lactic acid has been rapid or promises to be, it may be well, when the curd has reached 98 degrees F., to let it settle and draw off part of the whey, leaving enough to cover the curd two or three inches deep. Then the rest of the curd can be removed when the curd strings one-eighth of an inch. Too much acid at this point must be guarded against, and the whey must be promptly removed when the right point is reached.

56. Cheddaring the Curd.

This operation is the distinguishing feature of the cheddar method. It consists essentially in allowing the curd to mat or pack together in solid chunks after the removal of the whey. The matting process may take place in the vat directly on the bottom or on curd-racks placed in the bottom of the vat or it may be removed to a special apparatus called a curd-sink.

(1.) Matting Curd on Vat-Bottom.—When the bottom of the vat is used, the curd, after the removal of whey, is piled up along the two sides of the vat with an open channel between the two piles of curd to facilitate the running off of the whey that drains from the curd. When the particles of curd have matted together, forming one solid mass, it is cut into chunks or blocks about 8 by 8 by 12 inches; these blocks are then turned over so that the part at first uppermost comes against the bottom of the vat. Some whey drains out and then the blocks are piled two deep, care being taken to turn in the parts that have been exposed to the air. Later, the curd is re-piled in still deeper piles. This re-piling continues again and again, always observing the precaution to expose to the air the portions that were turned inside on the previous piling. The object of this is to keep the heat uniform through the mass.

(2.) Matting Curd on Curd-Rack in Vat.—In this case racks are used, made of wooden slats, just fitting nicely into the bottom of the vat (see Fig. 6). They are preferably made in four-feet sections. For their use, the vat is tipped and the curd shoved to the lower end. One section of rack is then placed in the empty end of the vat and a linen strainer thrown over it, the strainer being long enough and wide enough to come up over the sides of the vat. Then the curd is piled onto the rack, and broken apart to let the whey escape. After stirring over several times, it is allowed to mat evenly about six inches deep. If needed, the second section can be put in place and used for the rest of the curd, and then the whole is covered with the strainer cloth to keep warm and, if necessary, the whole vat covered with an additional heavy cloth. After ten or fifteen minutes, the curd is matted together, when it is cut into blocks and treated as described above.

(3.) Matting Curd in Curd-Sink.—After most of the whey is removed, the curd and remaining whey are dipped into the curd-sink and allowed to drain. Then proceed to mat, cut, pile and re-pile as stated above. All things considered, the use of a curd-sink is advantageous.

Piling curd has a tendency to make a quick-curing, soft cheese. If a slow-curing cheese is desired, the curd should be piled only a little or none at all, the blocks being simply turned over and over in a single layer. A curd from very ripe milk should not be piled much.

Cheddaring, or matting curd, accomplishes two results. First, the whey is expelled to a considerable extent and, second, the lactic acid unites with more of the curd, thus changing not only the chemical composition but the physical condition of the curd. From a spongy, tough, rubber-like consistency, with a high water content, the curd changes to a mass having a smooth, velvety appearance and feeling, and a softer, somewhat plastic, consistency. The texture also changes so that the curd acquires a peculiar fibrous condition or grain, tearing off somewhat like the cooked meat of a chicken's breast. Then, in addition, owing also to the increase of the compound formed by the curd with lactic acid, the curd forms longer strings on a hot iron, probably an inch or more after the cheddaring has continued some time. Usually, when the curd strings one inch and the other physical appearances of the curd are as described above, the curd is ready for milling.

57. Milling the Curd.

Milling curd consists simply in cutting it into small pieces in order to salt it and handle it conveniently in putting it into hoops for pressing into a solid mass. Several mills are on the market for this purpose. The best machines cut the curd into pieces of uniform size, without tearing it in pieces. When properly milled, there is less loss of fat and the curd is more evenly salted. After milling, the curd is piled up to flatten out the pin-holes and then stirred enough to keep it from matting together, perhaps every fifteen minutes. The time for milling should come about half way between removing the whey and salting the curd. The breaking down or softening of the curd continues after milling, as a result of further formation of lactic acid and its combination with the paracasein of the curd. When the curd forms strings on a hot iron about two inches long, it should be salted. During all this time the curd should be kept warm.

58. Salting and Pressing Curd.

(1.) Salting.—Salt is added to curd chiefly for the flavor it imparts, but the presence of the salt produces several other effects. It aids in removing whey; it hardens the curd; it checks or retards the formation of lactic acid. In the absence of salt a cheese cures more rapidly and is apt to develop a bitter flavor even at moderately low temperatures. Excessive salting makes a cheese mealy because too dry and the cheese cures very slowly.

A salt of fairly coarse grain is preferable for cheese, because it dissolves more slowly and reaches farther into the pieces of curd. When the salt is added, the curd is spread out thin in order to cool to 90 degrees F., and the salt is mixed uniformly through the curd. Then the curd is stirred until the salt is completely dissolved. In respect to the amount of salt to use, the usual amount is two and one-half ounces to three pounds of salt for the curd made from 1,000 pounds of milk. A moist curd should be salted somewhat more.

(2.) Pressing.—Before pressing, the curd should be cooled to a temperature between 78 degrees F. and 84 degrees F. If put in press warmer than this, the fat runs out and is lost and it also prevents the pieces of curd sticking together perfectly. If curd is put in press much below 80 degrees F., the pieces do not cement completely and so fail to form a solid mass. The main object of pressing is to give the cheese a definite form for market and not to squeeze out whey, though this is done to some extent. The whey should be removed from the curd while it is in the vat. No amount of pressure can make up for failure to remove the whey at the proper time. If the process has been properly carried on so as to form a proper amount of the compound of lactic acid and paracasein, and if the temperature of the curd, when put in the press, is not much below 80 degrees F., a comparatively light pressure will be sufficient to cause the pieces of curd to cement together in a smooth, uniform and solid mass. The pressure should be uniform and continuous for twenty-four hours. When a screw press is used, the pressure must be applied gradually at first and care must be taken, especially during the first hour of pressing, to tighten the screws as quickly as they become loose.

When the cheese has been in press about one hour, it is taken out, turned, the bandage straightened and the entire surface of the cheese wiped with a cloth wrung out of hot water. Seamless bandage is used, being cut long enough to extend over the edges on both ends of the cheese one and one-half to two inches. When the cheese is put back in press, circular cloth caps are put on between the ends of the cheese and the follower and are allowed to remain.

59. Some Common Troubles of Cheese-Making.

The conditions of temperature present during the cheese-making process are extremely favorable to the growth of many kinds of bacteria and, when certain kinds are present, we have undesirable forms of fermentation, producing abnormal behavior in the curd and defective cheese.

(1.) Gas-Forming Fermentations.—One of the common troubles in cheese-making is a "floating," or "gassy" curd. This fermentation produces gas in the curd and bubbles of gas cause the curd to swell, filling it with small holes, so that it becomes very spongy. When the gas is sufficiently abundant, it makes the curd light enough to float on the surface of the whey. The small gas holes can easily be seen inside the pieces of curd by cutting across them. They are usually known as "pin holes," forming a "pin-holey" curd. The source of this fermentation is commonly lack of cleanliness on the part of one or more patrons, and the different milks should be tested by the curd test (see Section 48, p. 64), in order to detect the offending party. However, if one is suspicious of the presence of such fermentations in the milk, they can usually be prevented or lessened by abundant use of a starter, developing abundance of lactic acid in the curd. It has been found that these gas-forming bacteria do not usually develop in the presence of vigorous lactic acid fermentation. The milk is well ripened before adding rennet and the temperature used in heating the curd is raised somewhat more rapidly and two to six degrees higher than usual. The curd is kept warm after removing whey and the escape of gas is favored by frequent turning and re-piling of the curd, thus closing the pin holes. The gas-forming fermentations often produce offensive-smelling gases. When these are present in curd, they may be washed out by drenching the curd with hot water. When a floating or spongy curd is not properly treated, the resulting cheese is defective in texture and flavor, and even when these defects are prevented, there is extra loss of fat and of cheese yield. Prevention by cleanliness is the best method of treatment.

(2.) Over-ripe Milk.—In some cases, especially in hot weather, the milk may have developed too much lactic acid and be on the verge of souring when brought to the factory. When there is so much lactic acid at the start, the changes in the curd take place much more rapidly than usual, or, as the cheese-maker says, the curd "works fast." Under these conditions, the whey does not escape from the curd rapidly enough, that is, the curd has not shrunken enough when it comes time to remove the whey. Under these conditions, the curd is constantly and thoroughly stirred after the whey is removed and the whey is thus well worked out before the cheddaring begins. When it is known at the beginning that the milk is over-ripe, the milk should not be heated to the usual temperature before adding rennet, and a larger amount of rennet is used. After cutting, the curd is stirred until the whey is well separated before applying additional heat.

60. Sizes of Cheese.

The sizes in which cheeses are made depend upon the special market in which one's product is sold. The most common size is 15 inches in diameter and weighs from 60 to 65 pounds. Cheeses of the same diameter and one-half the weight are known as "flats." Other sizes are 13 and 11 inches in diameter. Cheeses 7 inches in diameter are known as Young Americas, usually weighing 8 to 10 pounds.

CHAPTER IX.

CURING CHEESE—QUALITIES OF CHEESE.

The importance of care in managing cheese after it is made has been seriously overlooked. Until quite recently, little attention has been given to methods of cheese-curing in this country. The rule has been and still is, in too many cases, to place the cheese in some room in the factory that is provided with no means of controlling temperature and moisture, where the variations in these factors follow the conditions existing out of doors. It is now being realized that the best-made cheese may be absolutely ruined for market by lack of care during the curing process. The curing of cheese is a part of the manufacturing process and must not be slighted any more than any other important step.

61. Changes Caused by Curing Cheese.

It is well known that cheese must have age before it is salable for consumption. What takes place in cheese while it is acquiring age, that is, while it is curing or ripening? Several different changes occur, which we will briefly notice.

(1.) Loss of Moisture.—It is well known among cheese-makers that cheese begins to lose weight immediately from the time it is taken from press and placed upon the shelves of the curing room, and this loss continues for a long time. The rapidity and extent of loss of moisture in cheese during the process of curing vary with several conditions, such as (a) the percentage of moisture originally present in the cheese, (b) the texture of the cheese, (c) the size and shape of the cheese, (d) the temperature of the curing room, and (e) the proportion of water vapor present in the air of the curing room. The more moist a cheese is when first made, the more rapidly it loses moisture. Cheese with spongy texture loses moisture more rapidly than does cheese with perfect texture. Large cheeses lose moisture less rapidly in proportion to their weight than smaller cheeses. "Flats" lose weight more rapidly than cheeses of the same diameter and twice the height. The higher the temperature of the curing room the greater the loss of moisture. The greater the moisture in the air of the curing room the smaller is the loss of weight.

(2.) Changes in the Paracasein.—In freshly coagulated cheese-curd, the milk-casein has been changed to paracasein, and, with the formation of lactic acid in cheese, the paracasein unites with the acid forming a new compound. Fresh cheese has always been supposed to consist entirely of paracasein, except for the fat, moisture and salt. It has recently been discovered in the laboratory of the New York (Geneva) Agricultural Experiment Station that fresh or green cheese instead of containing paracasein, contains the lactic acid compound of paracasein. Now this compound undergoes changes in the course of ripening, which greatly change the whole character of the cheese. Green cheese is tough, somewhat rubber-like, not appreciably soluble on the tongue, difficult of digestion, and lacking flavor. In the course of ripening, the cheese becomes more or less soft, more easily digestible and acquires characteristic flavors. A piece of well-cured cheese, when placed on the tongue, should dissolve somewhat like a piece of cold butter, leaving no trace of harsh or gritty-feeling particles. Just how the flavor is produced or where it comes from we do not know with certainty. In normal cheese-ripening, the fat undergoes little or no change. The curing process in cheese involves the change from unmarketable to marketable conditions. The exact causes of these changes are not clearly known yet; it is probable that they are due to the combined action of galactase, the enzyme in milk, to the pepsin enzyme in rennet, and to certain forms of bacteria.

62. Temperature for Curing Cheese.

It has been found that cheese cures more quickly at higher temperatures and that, above certain temperatures, the texture and flavor are unfavorably affected. It was formerly thought that a temperature of 70 degrees F. was about right for best results. But it is now known that a temperature of 55 degrees F. or 60 degrees F. gives very much better results, and it is thought that a temperature as low as 40 degrees F. may be still better. Cheese cured at 75 degrees F. or above will suffer more or less from leakage of fat. It may be said with positiveness that cheddar cheese cured above 60 degrees F. does not give cheese of the best quality, either in respect to general character or in respect to keeping qualities. Cheese cures more slowly at lower temperatures, but the product is superior in quality. In addition, at low temperatures, less moisture is lost and one has more pounds of cheese to sell.

63. Moisture in Air for Curing Cheese.

The relative amount of moisture in air can be shown by an instrument (see Fig. 7), called a hygrometer, or hygroscope, which can be purchased at dairy-supply houses. The relative amount of moisture for a curing room for cheddar cheese is from 65 to 75 per cent; the nearer the latter figure the better.

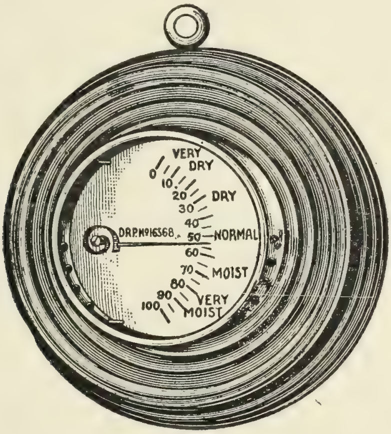

Fig. 7. Hygrometer.

64. How to Control Moisture and Temperature in Curing Rooms.

Ordinarily, each factory must provide for itself a suitable kind of curing room, if it cures its cheese properly. Of course, cheese may be sold and removed from the factory before it is a week old and the whole process of curing placed in the hands of the buyer, who will gain the benefit of the increased value of the well-ripened cheese. This, however, is better than keeping cheese at the factory and spoiling it. In some cases several factories may unite to build a central curing-house, to which the cheese, while still green, can be removed from the factory. But, in many cases, the factory is the place where the curing-room will have to be built if anywhere.

The following statements are, for the most part, condensed from Prof. F. H. King's Wisconsin Bulletin No. 70. The cuts are from the same source.

Curing-rooms may be constructed above ground or under ground and may be of wood or masonry, or a combination. Considering moderate cost, convenience and efficiency, a curing-room built of wood entirely above ground is the most practicable for the average factory.

(1.) Location.—A curing-room above ground should be placed on the north side of a building in order to be protected as much as possible from the direct rays of the sun. It is advantageous also if the room can be shut off on the other three sides by hallways, stairways other rooms or building screens.

(2.) Windows in a curing-room should be as few and as small as consistent with the amount of light necessary. They should be made double, as nearly air-tight as possible, and preferably in one section, fitted closely and permanently in place. If necessary to exclude direct sunshine, blinds or awnings should be placed outside.

(3.) The door of a curing-room should be built to resemble that of a refrigerator.

(4.) Walls should be built like those of cold-storage and ice-houses. The studding outside should be covered with matched sheathing and drop siding, with a layer of three-ply acid and water-proof paper between. The paper recommended by Prof. King is manufactured

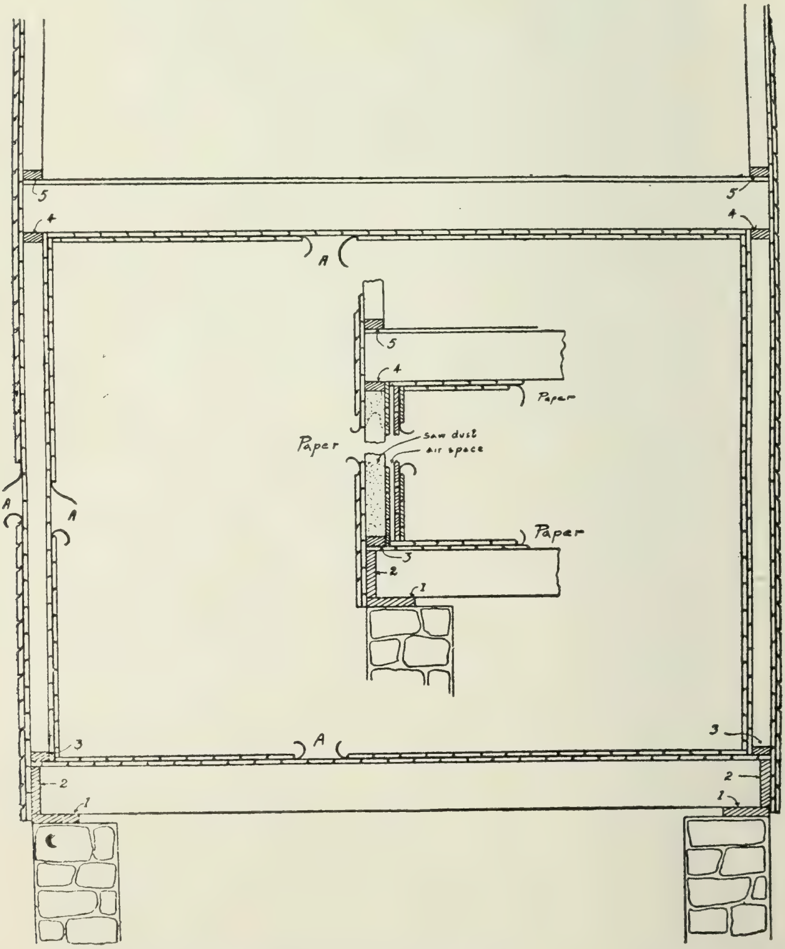

Fig. A. Showing the construction of wood curing-room. 1, 1, 1, sill; 2, 2, 2, a two-by-ten spiked to ends of joist; 3, 3, 3, a two-by-four spiked down, after first layer of floor is laid, to toe-nail studs to; 4, 4, 4, a two-by-four spiked to upper ends of studding of first story. A, A, A, A, three-ply acid and water-proof paper. The drawing in the center shows space between studding filled with saw dust and another dead-air space to be used when the best ducts cannot be provided.

(From Wis. Agr. Exp. Sta. Bul. 70.)

by the Standard Paint Company, New York and Chicago. In the inside a layer of matched sheathing is nailed to the studding, then strips of inch furring two inches wide, to which are nailed two thicknesses of matched sheathing, with paper between. The outer air space between the studding is filled with sawdust or similar material and the spaces left by the furring are closed air-tight at the ceiling and floor. (See Fig. A.)

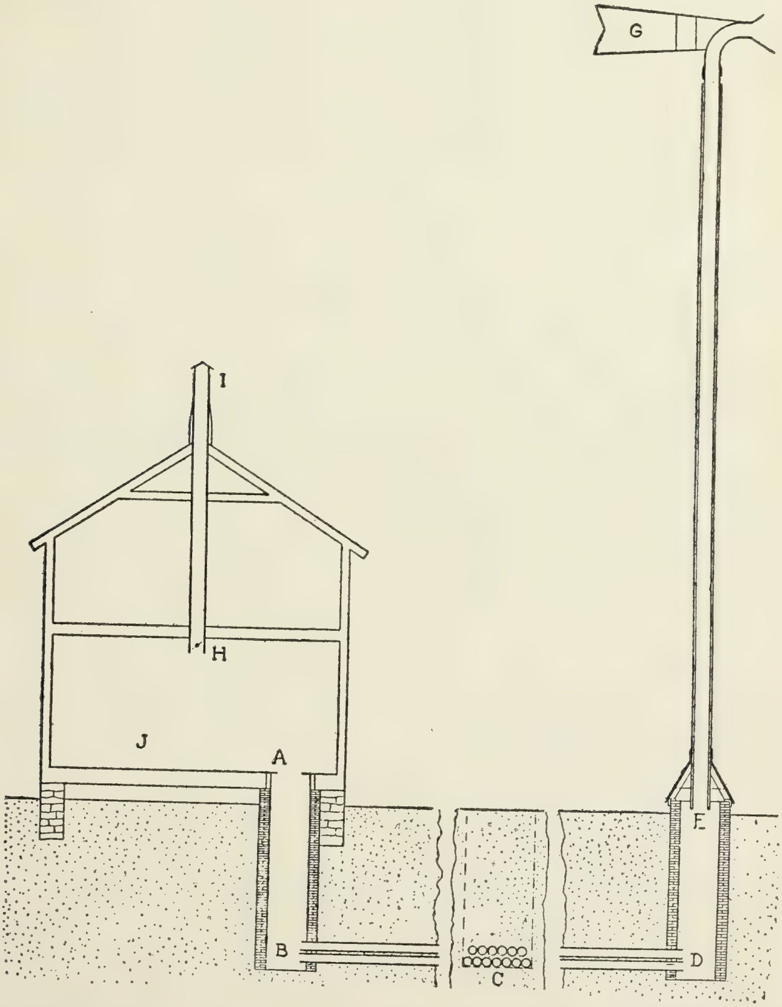

Fig. B. Section of cheese-curing room and horizontal multiple sub-earth duct. A, inlet to curing room; B, end of sub-earth duct in bricked entrance to factory; C, cross-section of the multiple ducts; D, E, bricked entrance under funnel at outer end of sub-earth duct; funnel with mouth 36 inches across; G, vane to hold funnel to the wind; H, ventilating flue with damper.

(From Wis. Agr. Exp. Sta. Bul. 70.)

(5.) Ceiling and floor should also consist of two thicknesses of matched lumber with paper between, and joints made at corners should be very tight.

In constructing curing-rooms two things should be kept in mind; first, that the walls should be as nearly air-tight as possible in order to keep out the warmer air outside and, second, that the walls should be poor conductors of heat. It is advantageous to cover the inside walls with two coats of shellac.

(6.) Ventilating flue in ceiling.—It is desirable to provide a tight ventilating flue in the ceiling of the curing-room, extending above the roof. Its diameter may be six to eight inches. It should be provided with a damper. (See Fig. B, H, I.)

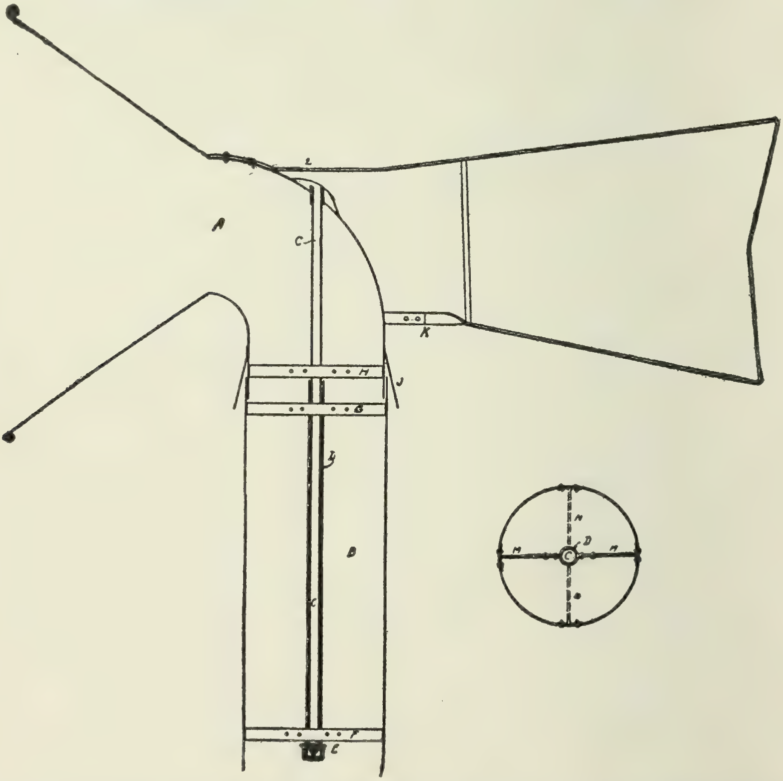

Fig. C. Showing how the funnel and vane may be mounted. A, funnel; B, shaft of funnel; C, C, C, 1-inch gas pipe; D, D, 1¼-inch gas pipe; E, cap for support of 1-inch gas pipe; F, G, H, and M M and N N are stays of band iron bolted together and to the sides of the shaft to support the axis of the funnel; J, weather collar to turn rain out of shaft. K, L, band-iron to stiffen vane and attach it to funnel.

(From Wis. Agr. Exp. Sta. Bul. 70.)

(7.) Methods of Controlling Temperature and Moisture in Cheese-Curing Rooms Placed Above Ground.—After constructing a proper curing-room, it is essential to provide arrangements for controlling temperature and moisture. The construction of a curing-room is only a partial means toward this end. The following methods have been found effective in keeping the temeprature during summer between 58 degrees and 70 degrees F. and at the same time modifying the moisture content of the air favorably: (a) Ventilation by air forced through horizontal sub-earth ducts or deep vertical sub-earth ducts and wells. (b) Ventilating over ice. (c) Evaporation of water.

Fig. B illustrates the construction of a horizontal sub-earth duct, which should be twelve feet or more below the surface of the ground and 100 feet or more in length. It is recommended that the sub-earth duct of three rows of 10-inch drain tile laid side by

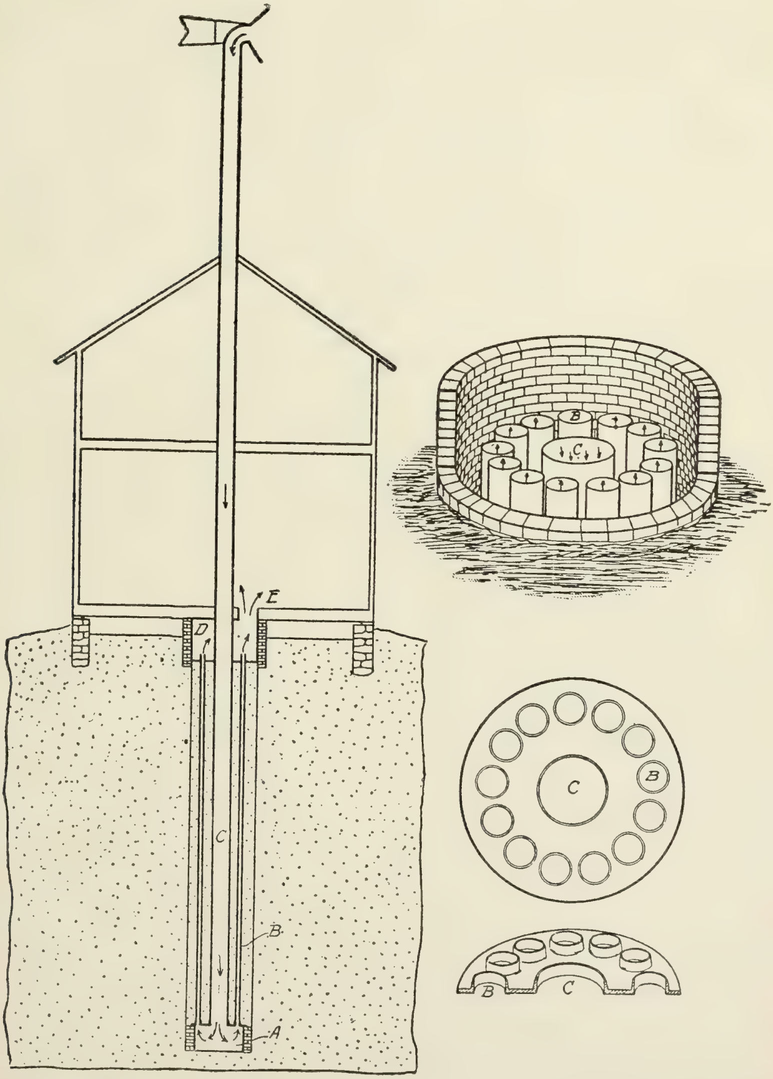

Fig. D. Showing vertical sub-earth duct. A, brick chamber 25 to 30 feet below surface and 40 inches inside diameter; tile or conductor pipe of galvanized iron; C, main shaft of funnel; D, brick chamber at upper end of duct. The circle and section represent a cast-iron plate to cover brick chamber A, and can be had of King & Walker, Madison, Wis.

(From Wis. Agr. Exp. Sta. Bul. 70.)

side at the bottom of the trench, or the trench may be dug narrower and one or two feet deeper and the tile placed one above the other. The shaft for carrying the funnel must be made tight; it may be twelve inches square, if made of plank, or twelve inches in diameter, if made of galvanized iron. The height should be sufficient to enable the funnel to catch the wind readily. The construction and mounting of the funnel are illustrated in Fig. C. The extreme diameter of the funnel should be about thirty-six inches.

The inlet from the sub-earth duct into the curing-room must be provided with some arrangement of valves that will permit the air to be shut off wholly or partly. Too rapid entrance of air in warm weather will not permit enough cooling during passage through the duct. In case of dry winds, too rapid entrance would reduce the moisture too much.

In Fig. D there is illustrated a deep vertical sub-earth duct. Such a duct has the advantage of requiring less piping and also less wind will suffice to produce a current of air. The vertical duct should have a depth of not less than twenty-five or thirty feet, provided water is far enough from the surface. Thirteen lines of 6-inch drain or 5-inch galvanized iron conductor pipe may be used and placed as in the cut. The duct should be located near the north end of the curing-room or directly beneath it. A hanging platform can be used in placing the pipes or tubes in position and the earth packed carefully around the pipes. An excavation of proper size, made as for an ordinary well, will answer the purpose. After the duct has been placed in position, the earth that has been removed can be used for filling around the duct.

In Canada, considerable work has been done in using ice in curing rooms to control temperature. Where ice can be obtained conveniently and cheaply, this method may be advantageously utilized. One or more ice boxes are placed in the curing-room, so built that air can circulate about the ice and into the curing-room. Also compartments, filled with ice, may be made adjoining the curing-room on the side or above, provided with openings into the curing room which will allow a flow of air over the ice and into the curing-room.

Where special means are needed to secure moisture, this can be effectively done by means of yard-wide strips of any cloth material that has good capillary power. The pieces of cloth are hung about the room and kept more or less saturated with water. Experience will tell how much evaporating surface is needed to provide the degree of moisture needed.

65. Qualities of Cheese.

Certain qualities of American cheddar cheese have been adopted as a basis in judging of the commercial value of one cheese as compared with another. The terms used in expressing these qualities are the following: (1) flavor, (2) body, (3) texture, (4) color and (5) general appearance.

(1.) Flavor.—By flavor, as applied to cheese, we mean the odor of the cheese, or really odor and taste combined. The sense of smell is, as a rule, more sensitive in detecting variations of flavor in cheese than the sense of taste. Flavor in cheese is said to be perfect when it resembles that of first-class butter, with an added something of its own that can not be described. The proper cheese flavor should be marked but not strong. The flavor should be free from all other flavors, referring particularly to the more or less offensive products of undesirable fermentations. The taste should be mild and somewhat lasting, but not be so sharp as to "bite" the tongue.

Tainted flavors are numerous in kind and name. They may resemble the odor of the cow or the stable; others are characterized as "sweet and sickish;" others suggest the odor of rotten eggs, and others putrefactive smells. There is the "off" flavor of rancid butter, produced by too long keeping under improper conditions. This list is far from exhaustive.

(2.) Body.—This term, as used in reference to cheese is not easy to define; it means about the same as substance. A cheese is said to have a perfect body when it is solid, firm and smooth in substance. This quality is ascertained by pressing cheese between the fingers. The body is said to be solid and firm, when it shows a certain amount of resistance under pressure, somewhat like that of a piece of fat pork. When it does not press down readily and is tough, the body is said to be "corky." The body is said to be smooth when, under pressure between the thumb and fingers, it feels smooth and velvet-like, as opposed to harsh or gritty or mealy. The firmness of body may be diminished by excessive moisture or by large amounts of fat relative to paracasein compounds, while the smoothness may be increased. The harsh or gritty feeling in cheese may be produced by removal of fat from milk, by excessive acidity in milk, by too much salt, or by any condition that retards or prevents the normal ripening of the cheese.

(3.) Texture.—Texture, as applied to cheese, refers mainly to compactness. Uusually the body is considered as a part of texture, but the two qualities are usually quite distinct. The texture may be fine and close or porous. The texture is perfect when a cut surface of the inside of the cheese presents to the eye a solid, compact, continuous appearance, free from breaks, holes and chunks. A porous texture of any kind is imperfect. When a plug is drawn from the cheese, it should be smooth and not "fuzzy." When the plug is broken in two, it should not crumble, but show a flaky appearance, termed a "flinty break," resembling the surface of broken cast-iron or broken flint. Cheese should show no visible or separated moisture and no fat, separate from the main body of the cheese.

(4.) Color.—Cheese, whether artificially colored or not, should be uniform in color and free from any mottled appearance. When held between the eye and the light, it should be slightly translucent.

(5.) General Appearance.—The rind of cheese should be smooth, free from cracks, and fairly hard. The bandage should be smooth and neatly and uniformly rounded over the edges about two inches on each end of the cheese. The sides of the cheese should be straight and of uniform height all around. The following scale of points is in use in judging cheese according to these qualities:

Flavor, 45 to 50.
Texture, 30 to 35.
Color, 10 to 15.
General appearance, 5 to 15.

CHAPTER X.

THE RELATION OF MILK TO CHEESE.

For a long time, attention was so completely absorbed by methods of cheese-making that very little was accurately known up to ten years ago about the general principles underlying the methods employed. Less than a dozen years ago we were completely in the dark in regard to such fundamental facts as the relation of fat and casein in milk to yield and quality of cheese, the character and extent of losses of milk constituents in cheese-making, their causes and remedies, the influence of removing fat from milk upon the composition of cheese, and in general, the detailed relations existing between cheese and the material from which it is made.

66. Relation of Composition of Milk to Yield of Cheese.

Not many years ago there was a widely prevalent, if not universal, belief that all kinds of milk were practically of equal value for the purpose of making cheese. This belief was based upon two assumptions, (1) that it is impossible to retain the fat of milk in cheese when the milk-fat exceeds 3½ or 4 per cent., and (2) that the amount of casein is practically the same in all kinds of milk. What are the actual facts?

(1.) Proportion of Milk-Fat Lost in Cheese-Making in Different Milks.—Careful and extensive investigations have shown clearly that the amount of fat lost in the process of cheese-making varies comparatively little whether the milk contains more or less fat. The following tabulated summary represents averages obtained with a very large number of experiments carried on by the writer with normal milk varying in fat content from 3 to over 5 per cent.:

Group.	Pounds of fat in 100 pounds of milk.	Pounds of fat lost in whey for 100 pounds of fat in milk.	Per cent. of fat in milk lost in whey.
One,	3 to 3.5	0.32	9.55
Two,	3.5 to 4	0.33	8.33
Three,	4 to 4.5	0.32	7.70
Four,	4.5 to 5	0.28	5.90
Five,	5 to 5.25	0.31	6.00

An examination of the figures in the third column, shows that about the same amount of fat is lost in the whey for one hundred pounds of milk, whether the milk contains 3 per cent. or more of fat. Looking at the figures in the last column, we see what proportion of the fat in milk is lost in the whey. Thus, when the milk contains 3 to 3.5 per cent. of fat, 0.32 pound of this fat is lost for 100 pounds of milk, which is 9.55 per cent. of the amount of fat in the milk. The proportion of fat grows actually less as the milk becomes richer in fat. As a rule, the loss of fat in cheese-making is quite independent of the amount of fat in milk.

(2.) Amount of Casein in Different Milks.—In regard to the second assumption made above, that the amount of casein is practically constant in all kinds of milk, we can say that our work and the work of others does not justify the statement. As a rule, when fat in milk increases, the casein also increases, though not in quite the same proportion. Above 4.5 per cent. of fat, the casein appears to increase less rapidly than in milks containing less than 4.5 per cent. of fat. In the tabulated data given below, one can see about how fat and casein are related to each other in milk containing different amounts of fat:

Per Cent. of Fat in Milk.	Per Cent. of Casein in Milk.
3	2.10
3.25	2.20
3.50	2.30
3.75	2.40
4.00	2.50
4.25	2.60
4.50	2.70

In general, when the fat increases one-fourth of one per cent., the casein increases about one-tenth of one per cent..

Now, we wish to make use of the foregoing facts in showing that the composition of milk does necessarily influence the yield of cheese.

(3.) Increase of Cheese Yield with Increase of Fat in Milk.—We must bear in mind that the two solid constituents of milk which are chiefly concerned in making cheese are fat and casein. We have just seen that when milk grows richer in fat it also grows richer in casein, and richer milks therefore contain larger quantities of the materials that make cheese. Since the yield of cheese depends primarily upon fat and casein, and since these costituents vary in milk, it must follow that the cheese yield depends upon the composition of the milk, varying as the fat and casein in the milk vary. In the following table, we give the approximate yield of cheese for milk containing different amounts of fat, varying from 3 to 4.5 per cent.

Per Cent. of Fat in Milk.	Pounds of Cheese Made from 100 Pounds of Milk.
3	8.55
3.25	9.10
3.50	9.60
3.75	10.10
4.00	10.65
4.25	11.20
4.50	11.70

These figures show that as milk grows richer in fat the same amount will make more cheese. In average cheese-factory milk, the approximate amount of green cheese can be found by multiplying the per cent. of milk-fat by 2.7.

67. Losses of Milk Constituents in Cheese-Making.

What constituents of milk are normally lost in cheese-making? What amounts are to be regarded as normal losses? What causes the necessary losses? What conditions produce unnecessary losses?

(1.) Cheese-Producing and Whey-Producing Solids in Milk.—Of the milk constituents, most of the water, albumin and sugar goes in to the whey, with more or less of the mineral constituents, together with small amounts of fat and casein. We may, therefore, call the albumin and sugar and water whey-producing constituents, while the casein and fat are cheese-producing constituents. Of course, some water and small amounts of albumin and sugar go into the cheese. In the following table we illustrate how these different constituents of milk are distributed in the whey and cheese:

Table Showing Distribution of Milk-Constituents of 100 Pounds of Milk in Whey and Cheese.

	Pounds.	Pounds of water.	Pounds of milk-solids.	Pounds of fat.	Pounds of casein.	Pounds of albumin.	Pounds of milk-sugar.	Pounds of ash.
Milk,	100	87.00	13.00	4.00	2.50	0.75	5.00	0.75
Whey,	89.35	83.00	6.30	0.30	0.10	0.72	3.50	0.72
Cheese,	10.65	4.00	6.70	3.70	2.40	0.03	1.50	0.03

On an average, 49.5 per cent. of the milk solids goes into the whey, and 50.5 per cent. into the cheese. In poor milks, a larger proportion of the solids goes into whey; in rich milks, a larger proportion goes into cheese; in other words, milk rich in fat contains a larger proportion of cheese-producing solids than does milk poorer in fat. Put in another way, of the solids contained in 100 pounds of average factory-milk, about 6.25 pounds go into whey and 6.50 pounds into cheese.

(2.) Loss of Milk-Fat in Cheese-Making.—For 100 pounds of milk, there is lost in whey in cheese-factory work from 0.20 to 0.50 pound of fat; the average is 0.33 pound. As we have stated previously, the amount of fat lost in cheese-making is practically independent of the amount of fat in the milk used. When a cheese-maker says that he cannot make cheese from normal milk containing over 3.5 or 4 per cent. of fat without having extra large losses of fat in whey, he classes himself as an incompetent workman.

Why is it necessary to lose any milk-fat in cheese-making? We have seen that fat is present in milk in the form of very small balls or globules, distributed through the milk in enormous numbers. Now, when rennet coagulates or solidifies the milk casein throughout the mass of milk, the fat-globules are retained or imprisoned in the solidified mass just where they happen to be at the instant coagulation takes place. When the curd knife passes through the solid mass, large numbers of fat-globules are exposed on every cut surface, and many of these fall into the whey and so are not retained in the cheese.

What conditions contribute to loss of milk-fat in cheese-making? In abnormal milk, when the casein is small in amount in proportion to fat or when it fails to coagulate normally, there are extra losses of fat. Any condition that interferes with complete coagulation by rennet, such as marked dilution of milk by water, presence of preservatives like salt, formalin, etc., is likely to increase loss of fat. Jarring or stirring the milk after coagulation has commenced and before it is completed results in increased loss of fat. Other conditions causing abnormal losses of fat are cutting the curd when it is too soft or cutting it too fine; violent, careless and rapid motions of knife in cutting curd; heating curd too rapidly or too high; piling curd too much; putting curd to press too warm; too rapid application of pressure in cheese hoop. Fermentations producing floating curd, excessive acidity of milk and forms of fermentation that dissolve casein also contribute to losses of fat in cheese-making.

(3.) Loss of Milk-Casein in Cheese-Making.—The casein lost in cheese-making is probably lost mostly in the form of fine particles of coagulated paracasein, which pass through the strainer when the whey is removed from the curd. These minute particles can readily be seen by letting a pail of freshly-drawn whey stand until the curd particles settle, and then pouring off the whey, when a noticeable quantity of finely-divided curd can be seen at the bottom of the pail. This passage of curd into whey is not entirely avoidable, but is made needlessly greater by careless or violence in cutting curd and in subsequent handling, by agitation while drawing off the whey and by imperfect strainers. Any condition that interferes with the complete coagulation of milk-casein by rennet causes loss of casein. Some forms of fermentation convert the casein into compounds not acted on by rennet or dissolve the curd after coagulation, and thus cause a loss of 0.10 to 0.15 pound of casein, and this loss appears to be quite independent of the amount of casein in the milk.

68. Relation of Composition of Milk to Composition of Cheese.

It was formerly believed that cheese of the same composition is made from all kinds of milk. On this assumption the partial skimming of milk for cheese-making was defended.

(1.) In Normal Milk.—In the following table, we present some figures showing how the change in composition of milks affects the composition of the cheese made from those milks, the conditions of manufacture being the same:

Per cent. of fat in milk.	Per cent .of water in cheese.	Per cent. of fat in cheese.	Per cent. of paracasein compounds in cheese.
3	39.4	32.2	23.4
3.25	39.0	32.9	23.1
3.50	38.1	33.9	23.0
3.75	37.5	34.7	22.8
4.00	37.3	35.2	22.5
4.25	37.0	35.7	22.3
4.50	36.5	36.3	22.2

These figures show that in cheese made from poorer milk, the cheese contains in 100 pounds more water and more paracasein and less fat. As the milk grows richer in fat, the fat in the cheese increases in proportion to water and paracasein compounds. Hence, it is very clear that the composition of cheese is dependent upon the composition of milk, provided, of course, the cheese is made in a normal manner, so as to avoid excessive losses of fat.

(2.) In Skim-Milk.—In what respect does cheese made from normal milk differ from that made from milk which has had more or less of its fat removed? First, let us see in what way removal of fat from milk affects the composition of the milk. We will illustrate by taking milk containing 4 per cent. of fat and 2.50 per cent. of casein, and remove from the milk varying amounts of fat. The results are indicated in the following table. We assume here that we simply remove fat without any other constituents:

	Pounds of fat removed from 100 pounds of milk.	Pounds of fat left in 100 pounds of milk.	Pounds of casein in milk.	Pounds of casein for one pound of fat.
Normal milk,	0	4.00	2.50	0.63
Skim-milk,	0.50	3.50	2.50	0.71
Skim-milk,	1.00	3.00	2.50	0.83
Skim-milk,	1.50	2.50	2.50	1.00
Skim-milk,	2.00	2.00	2.50	1.25
Skim-milk,	2.50	1.50	2.50	1.67
Skim-milk,	3.00	1.00	2.50	2.50
Skim-milk,	3.50	0.50	2.50	5.00
Skim-milk,	4.00	0	2.50	....

With additional removal of fat from milk, the fat in milk decreases constantly, while we represent the casein that remains as being the same, though in actual practice it would increase a little. While in the normal milk the casein is very much below the fat in quantity, the casein gradually becomes nearer in amount to the fat until they are equal, after which further removal of fat steadily reduces the amount of fat below that of casein. These changed relations are shown in the last column. In normal milk, there is for one pound of fat less than two-thirds of a pound of casein. When 1.5 pounds of fat have been removed from the milk, the amounts of fat and casein in the resulting skim-milk are just equal, or as one to one. After taking out 3 pounds of fat from 100 pounds of milk, we have left in the resulting skim-milk two and one-half times as much casein as fat, and, with the removal of 3.5 pounds of fat, the remaining skim-milk contains five times as much casein as fat. We have already seen above what effect this has on the composition of cheese made from such milk. The casein and water rapidly increase in the cheese, while the fat decreases. The tabulated figures below give the practical composition of cheese made from some of the milks represented in preceding table:

	Pounds of fat removed from 100 pounds of milk.	Pounds of fat in 100 pounds of milk.	Per cent. of fat in cheese.	Per cent. of water in cheese.	Per cent. of paracasein compounds in cheese.
Normal milk and cheese,	0	4.00	37.3	35.2	22.5
Skim-milk and cheese, ...	1.00	3.00	31.4	37.4	26.2
Skim-milk and cheese, ...	2.50	1.50	19.0	44.4	31.6
Skim-milk and cheese, ...	3.50	0.50	7.3	50.7	37.0

(3.) In Milk Containing Added Cream.—The addition of cream to normal milk has, both upon the milk and the cheese made from it, an effect contrary to that produced by removing fat from milk. The greater the amount of cream added to normal milk, the greater will be the proportion of fat, both in the milk and in the cheese made from it, and the less in proportion will be the casein and water in both the milk and the cheese.

69. Composition of Milk in Relation to Quality of Cheese.

It has been well established that the relation of fat to casein in milk governs, to some extent, the commercial quality of the cheese, other conditions being the same. How closely dependent quality of cheese is upon the relation of fat to casein in milk we cannot say in all cases. Starting with extremes, we know that the character of skim-milk cheese, which is mainly casein and water and salt, is very different from that of whole-milk cheese. Skim-milk cheese is usually lacking in fine cheese flavor and is more often "off" in flavor, and usually contains abnormally large proportions of water. It acquires bad flavors easily. It is usually imperfect in texture and "corky" in body. We also know that cheese made from milk containing added cream is superior in flavor and other palatable qualities to that made from normal milk. As a rule, cheese made from the milk of Jersey or Guernsey cows is superior to that made from the milk of Holstein cows. In general, the greater the proportion of fat to casein in milk the better is the quality of the cheese made from such milk.

70. Standard of Composition for Whole-Milk Cheese.

How can we distinguish whole-milk cheese, commonly called "full creams," from cheese made from partially skimmed milk? As a rule, cheese made from normal milk will rarely be found to contain less than 32 per cent. of fat, even in the green cheese, and, of course, much less likely to when it comes into market after losing considerable moisture. Cheese made from normal milk would be apt to contain less than 32 per cent. of fat only in case of some abnormal conditions of manufacture, by which the cheese was made to contain an excessive amount of moisture or lose an excessive amount of fat in the process of making.

Then, again, if we take the solids of the cheese as a basis for a standard, we find that rarely, if ever, does cheese made from normal milk have its solids consist of less than 50 per cent. of fat. Taking the solids of average cheese, leaving the water out of consideration, we have in 100 pounds of cheese 35.2 pounds of fat, 22.5 pounds of paracasein compounds, and about 5 pounds of salt, ash, etc., making a total of 62.7 pounds of solids in 100 pounds of cheese, the rest being water. Now, of the 62.7 pounds of solids in 100 pounds of cheese, 35.2 pounds are fat, and this amount is 56 per cent. of the total solids. In this case the fat would have to drop below 31.5 per cent. in the cheese in order to be 50 per cent. of the total solids of the cheese.

71. Methods of Paying for Milk for Cheese-Making.

Until ten years ago or less, the universal custom prevailed of paying for milk at cheese factories by weight alone. This method was based upon the erroneous supposition that, for the purpose of making cheese, milk is milk, and that all kinds of milk are of equal value for cheese-making. The data presented in the preceding pages show by overwhelming evidence that these suppositions are false. We know that milk varies greatly in its composition and that the cheese-making value of milk varies with its composition.

In paying for milk for cheese-making, absolute fairness can be realized in every individual case only by a careful, direct determination of both fat and casein, the two solid constituents of milk that make cheese, but this is not practicable. However, fat in milk alone can be used as a fair basis in determining the value of milk for cheese-making, for the reasons (1) that the amount of cheese made from different milks is nearly, not exactly, in proportion to the amount of fat present in milk, and (2) that cheese made from milk rich in fat has a higher quality and market value than cheese made from milk poorer in fat.

When milk is paid for by weight alone, each patron receives the same amount of money for 100 pounds of milk, without any regard whatever for the composition of the milk or the amount of cheese it will make. The amount of cheese made from 100 pounds of each kind of milk specified in the table below is the sum of 8.55 pounds and 10.40 pounds, or a total of 18.95 pounds, which, at 10 cents a pound, brings 189.5 cents. This is divided equally between the two patrons, because each furnishes the same amount of milk. Hence, each receives 94.75 cents for the cheese made from his milk.

	Pounds of fat in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	Amount of money received when divided according to yield and composition of cheese, or on fat basis—Cents.	Amount of money received when divided according to weight of milk furnished—Cents.
A, ...	3	8.55	82.1	94.75
B, ...	4	10.40	107.4	94.75

When payment is made by the weight-of-milk method, A receives the same amount of money for 8.55 pounds of cheese that B receives for 10.40 pounds; A receives over 11 cents for each pound of the cheese made from his milk, while B receives only 9.1 cents a pound for the cheese made from his milk. A receives 31.6 cents for each pound of his milk-fat, while B receives only 23.7 cents for each pound of his. A receives for 100 pounds of milk 12.65 cents, which belongs entirely to B, because this extra money comes solely from the additional amount of more valuable cheese produced by the milk of B. One method makes no difference in the value of the milk furnished, while there actually exists a difference of 25.3 cents for 100 pounds of milk in favor of B. Estimated for a season, the difference between the dividends of A and B should be not less than $7.50 for each cow. That gross injustice is inevitably done, when milk is paid for by the weight-of-milk method, must become too obvious to require further discussion.

72. Calculating Dividends on Milk-Fat Basis at Cheese Factories.

In section 46, p. 60, details were given, showing how to calculate dividends at creameries when payment is made on the basis of the milk-fat. The same method applies in all details to the calculation of dividends on the milk-fat basis at cheese factories.

73. Composition of Whey.

Whey varies in composition according to the composition of the milk from which it comes and also according to the conditions of manufacture employed in cheese-making. The following table gives the extremes and average of composition of whey, as found in New York State cheese factories:

	Average.	Highest.	Lowest.
Per cent. of water,	93.04	93.57	92.48
Per cent. of total solids,	6.96	6.43	7.52
Per cent. of fat,	0.36	0.23	0.55
Per cent. of casein,	0.10	0.15	0.05
Per cent. of albumin,	0.72	0.90	0.45
Per cent. of sugar,	4.00	4.50	3.50
Per cent. of lactic acid,	0.20	0.25	0.16

In comparison with skim-milk and buttermilk, we notice in whey a smaller amount of casein and a little more fat. Whey may be used as food for calves and pigs, but is better used when sweet and in connection with other foods. The feeding value of whey has been estimated to be about seven cents per 100 pounds. It is a good plan to sterilize whey in the whey-vat and keep the vat as clean as possible.

74. Composition of Cheese.

We have already studied to some extent the variations found in the composition of cheese and the causes of these variations, as they are related to the composition of milk and conditions of manufacture. In the table following, we will give the average composition of cheese in the green condition and the same when ripened in condition for consumption:

	In green cheese—Per cent.	In ripened cheese—Per cent.
Water,	36.80	31.75
Solids,	63.20	68.25
Fat,	33.75	36.75
Paracasein, etc.,	23.75	25.50
Ash, etc.,	5.70	6.00

75. The Value of Cheese as Food.

There is more or less prejudice against cheese as an article of diet on the ground of its being indigestible. This prejudice has arisen, undoubtedly, because skim-milk cheese and uncured whole-milk cheese are difficult of digestion. Many of our American people want something very mild in flavor and pretty solid in consistency. They find these conditions in cheese partly cured and in well-made skim-milk cheese. For the average stomach, cheese should be cured two months or more, according to the temperature, before it is eaten. People should be taught to eat only well-ripened cheese. The test of the proper ripeness of cheese is that a piece placed on the tongue and held a little while dissolves completely. By curing at low temperatures for longer periods of time, it is easily possible to produce cheese showing this behavior and at the same time having a mild flavor. We will briefly consider some of the strongest claims cheese has as an article of diet.

(1). Cheese is One of Our Most Concentrated Foods.—Taking various common foods, and considering the amount of water and waste portions present in them and the amount of actual food materials contained in them, we can present the following figures:

	Pounds of water and waste material in 100 pounds.	Pounds of actual food material in 100 pounds.
Fresh fish,	90	10
Oysters,	88	12
Chicken,	83	17
Hens' eggs,	76	24
Round beefsteak,	71	29
Potatoes,	67	33
Ribs of beef,	65	35
Tenderloin beefsteak,	60	40
Bread, white,	45	55
Cheese,	33	67

These figures show very clearly that, of our more common foods, cheese is among the most highly concentrated.

(2.) Cheese is One of Our Cheapest Foods.—Taking average market prices and computing the price we pay for actual food materials, excluding water and waste, we have the following figures, as representing the cost of one pound of actual food material in the foods given:

Fresh fish,	$1 30
Oysters,	1 25
Chicken,	82
Eggs,	62
Ribs of beef,	50
Tenderloin beefsteak,	44
Round beefsteak,	42
Cheese,	22

(3.) Cheese furnishes a larger amount of protein than any other ordinary available food excepting canned and dried meats. Protein is an extremely valuable food constituent, furnishing, as it does, material for lean flesh, albuminoids, nitrogenous compounds of the blood, nerve tissues, tendons, skin, hair, etc. No other food element can take the place of protein. Cheese contains about one-fourth of its own weight of protein. The cost of protein in cheese is probably less than in any other food material, speaking of our American cheddar cheese retailing at 15 to 20 cents a pound.

CHAPTER XI.

METHODS OF TESTING MILK AND ITS PRODUCTS.

76. The Need of Tests.

It is necessary to ascertain the amount of some of the constituents of milk and of its products in order that we may be in position to judge the value of the materials in question for one purpose or another. Thus, at creameries, cheese factories and milk stations, it is necessary to determine the amount of fat in each patron's milk, in order to pay for the milk on the basis of the fat content. It is necessary for a dairyman who would be progressive to know the amount of fat in the milk of each individual cow of the herd, in order to know what the value of the cow is to him; because, only by such knowledge can one obtain the most profitable herd. Frequently, in making butter, it is desirable to know the amount of fat present in cream, also in the case of selling cream. Then, it is necessary, in butter-making, as previously pointed out (see section 28, p. 44) to determine the amount of acid in cream, frequently, also, in selling milk, in order to ascertain the approximate age of milk when it is received by the retailer. Another form of test that dairymen have occasion to make, especially where they purchase milk from other parties, is the estimation of solids in milk to find out if the milk has been adulterated by addition of water or by removal of fat. From these preliminary statements, it can readily be seen how important a part the testing of milk and its products plays in the problems which the dairyman constantly has before him.

77. The Babcock Test.

The Babcock test is a method for determining the amount of fat in milk and its products. It was devised in 1890 by Dr. S. M. Babcock, chief chemist of the Wisconsin Experiment Station. It is probably not too much to say that, in giving to dairymen this simple method of finding out how much fat a sample of milk contains, Dr. Babcock made the greatest contribution to the real progress of dairying ever made by any one man. There are other tests which are, more or less, imitations of the Babcock test, but none that, in all respects, equals it.

In general, this test is based on the action of strong sulphuric acid upon milk-casein, albumin and milk-sugar, by which the milk-fat is released from the influence of these other compounds and thus is free to collect in one separate mass. In order to hasten the complete separation of the fat from the rest of the liquid, centrifugal force is employed.

78. Advantages and Disadvantages of the Babcock Test.

Before describing in detail the method of employing the Babcock test, it is desirable to call attention to the special points of its merits and demerits.

(1.) Advantages.—(a.) The apparatus and materials are inexpensive, both in respect to first cost and also cost of making tests. (b.) The test is accurate enough for all practical purposes, giving the real per cent. of fat within two-tenths of one per cent., comparing most favorably with the most accurate laboratory methods. (c.) The test is quickly made, requiring less than fifteen minutes. (d.) The operation of the test is simple and easy. Only one chemical is used and no chemical training or knowledge is necessary to operate it.

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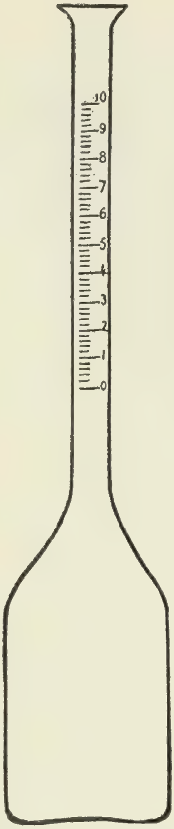

Fig. 8. Milk bottle.

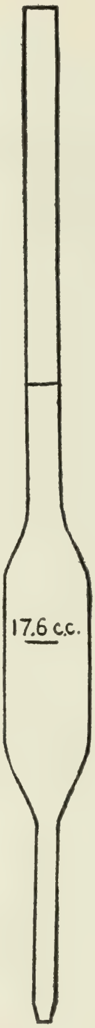

Fig. 9. Pipette.

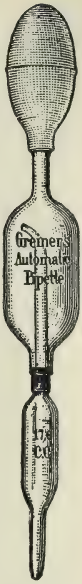

Fig. 12. Greiner's Pipette.

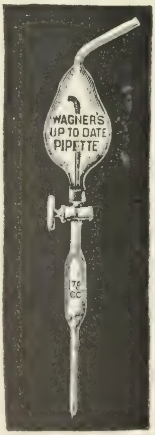

Fig. 11.

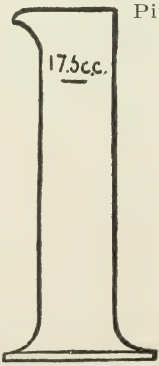

Fig. 10. Acid measure.

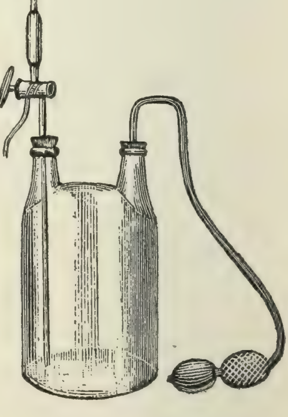

Fig. 13. Acid bottle.

(e.) The percentage of fat in each case is shown directly to the eye without special calculations or reference to tables. (f.) Only a small amount of milk is required to make the test. (g.) The apparatus does not readily get out of order and chances for accidents are absent with properly made machines. (h.) One sample or a large number of samples can be tested at the same time with the same facility. (i.) The results can be easily confirmed by repetition of tests. (j.) Completed tests can be set aside and will keep for future reference for a long time, if desired. (k.) The accuracy of the apparatus employed can be easily ascertained. (l.) Sour milk can be correctly tested, provided it can be correctly sampled. (m.) The test can, with some little modifications, be used in determining the amount of fat in cream, skim-milk, buttermilk, whey, condensed milk and cheese. (n.) The test is applicable to all kinds of milk of which good samples can be obtained, without regard to breed or other conditions.

(2.) Disadvantages.—(a.) Sulphuric acid, which is used in the test, is a dangerous substance, if handled carelessly. Therefore, its use requires constant attention and caution. (b.) The strength of the acid must be uniform and so must be examined from time to time. (c.) The speed of the centrifugal machine used must be properly regulated in order to secure correct results. (d.) The temperature of the milk at the beginning and end of the test must be controlled. (e.) The graduated glassware is sometimes incorrect. (f.) Attention must be carefully given to every detail of the operation, if correct results are to be obtained. These disadvantages, it will readily be seen, are all easily overcome. They are all practically summed up in the one requirement that careful attention must be given to all details. Any person who cannot be careful should not try to use the Babcock test in responsible work, much less should he try to use any other; in fact, such a person has no place in a creamery or cheese factory or in any dairy operations.

79. Description of Apparatus and Materials Used in Making Babcock Test.

(1.) Test Bottles.—The form of bottle used in this test is shown in Fig. 8. The neck is so graduated that each division represents two-tenths of one per cent. and five of the divisions represent one per cent. when 17.5 cubic centimeters or 18 grams of milk are used in the test. The graduation extends from 0 to 10 per cent., a range sufficient for all ordinary work with milk. When cheese or cream is tested for fat, a bottle like that shown in Fig. 18 or 19 is used. When skim-milk, buttermilk or whey is to be tested, bottles like that shown in Fig. 20 or 21 should be used according to directions given hereafter.

The divisions on the neck of the bottles should be uniform and the lines run straight across the neck, and not obliquely. When the numbers or lines become indistinct from having the blackened portions washed off, they can be restored by rubbing over the scale with a lead pencil or with a cloth having a little black paint on it. Each bottle should be numbered. A convenient way is to have the number stamped on a copper ring and slip this over the neck of the bottle.

The accuracy of the scale on the neck of the bottle can be approximately tested as follows: Fill the bottle to the mark with water, wipe out the neck of the bottle with a piece of filter or blotting paper and then measure into the bottle 2 c. c. of water with an accurate pipette; this should fill the bottle to the 10 per cent. mark. If bottles vary more than 0.2 per cent. in the whole length of the scale from 0 to 10 per cent., they should not be used.

(2.) Pipette for Measuring Milk.—A pipette like that shown in Fig. 9 is the form commonly used. This should hold 17.6 c. c. when filled to the mark. This will deliver about 17.5 c. c. of milk or 18 grams. It is important that the pipette should be accurate and should hold exactly the amount stated above. Other forms of pipette for measuring either milk or acid are shown in Figs. 11 and 12.

(3.) Measure for Acid.—A cylinder of glass like that shown in Fig. 10, with a lip to pour from and a single mark at 17.5 c. c. is the form commonly used. It is not necessary that this measure should be completely accurate, since the amount of acid used can be varied a little without affecting the test. In Figs. 13 and 14 are shown automatic pipettes which may be used to advantage where a large number of tests is made daily. This apparatus saves much time but has the disadvantage of being somewhat expensive and readily broken unless carefully handled. The automatic pipettes shown in Figs. 11 and 12 will probably be found to be the most convenient for the majority of those who use the test.

(4.) Centrifugal Machine.—Various forms of centrifugal machines have been devised for this work (see Figs. 15, 16 and 17). A wheel less than twelve inches in diameter should not be used and it need not exceed twenty inches. A wheel measuring twelve inches in diameter should be made to revolve 1,200 times per minute, while, for those of larger diameter, a smaller number of revolutions will suffice, but not less than 700 revolutions per minute should be used for the larger ones. It is better to use a machine in which the motion is transmitted by cog wheels, since, when the motion is transmitted by belt or friction, there is danger of slipping; and the result is much less motion than is intended and an imperfect separation

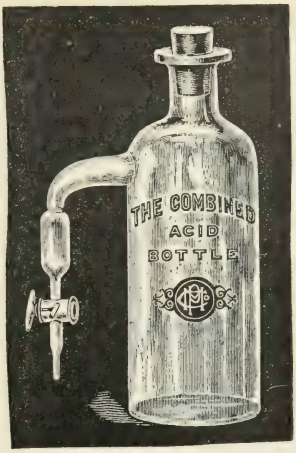

Fig. 14.

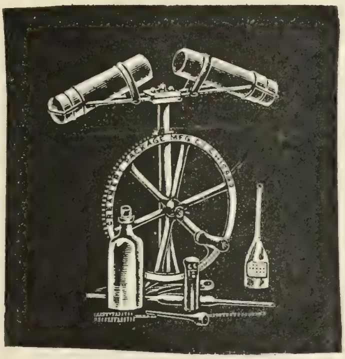

Fig. 15. Small-sized tester.

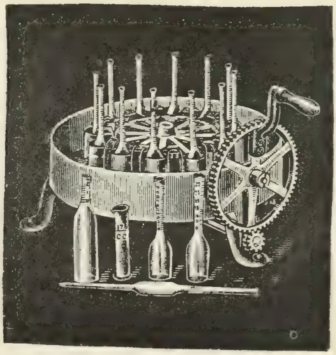

Fig. 16. Hand tester.

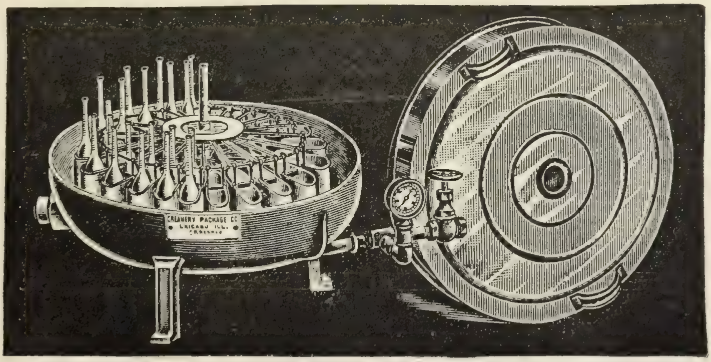

Fig. 17. Turbine steam tester.

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of fat. Machines which carry an even number of bottles are to be preferred. The best form of machine for use in factories is a steam turbine machine. They have the advantage of maintaining an even speed, they keep the bottles hot and supply distilled water for filling.

(5.) Commercial Sulphuric Acid (Oil of Vitriol).—This should have a specific gravity of 1.82 to 1.83. If the acid is much stronger, the fat will be dark in color and its amount hard to read. If the acid is weaker than 1.82, there is liability of some casein remaining undissolved and this will mingle with the fat and make the test unsatisfactory. If the acid is too strong, good results may be secured by using less. It is best to purchase acid at 1.82 or a trifle above and not attempt to dilute the strong acid. Dairy-supply houses should keep acids of the right strength made up in carboys for the trade. The acid should be kept in tightly stoppered bottles, because, if exposed to air, it rapidly absorbs moisture and becomes too weak. The stopper should be of either glass or rubber and, in no case should a common cork be used, since it would be quickly destroyed by the acid. Sulphuric acid is extremely corrosive and is dangerous to handle except with care. It quickly ruins clothing or leather on which it falls and seriously burns the skin if left in contact with the acid for a few minutes. If sulphuric acid gets upon the skin anywhere, it should be immediately and thoroughly washed with abundance of water. Too great care can not be exercised in handling this acid.

80. How to Sample Milk for Testing.

(1.) Conditions Making Sampling Difficult.—Milk that has soured and thickened or in which cream has risen and dried, so as to form a clot or skin, is difficult to sample properly and will generally be found to give low results. The same is true of milk in which the fat has been partially churned and formed into little butter granules that rise quickly to the surface. Such churning is liable to occur in milk that is transported long distances in vessels that are not full. However, these difficulties are seldom met in milk that has received careful attention in its preliminary handling.

(2.) How to Take a Sample of Milk for Testing.—The sample to be tested is thoroughly mixed by pouring the milk from one vessel to another two or more times, thus making every part of the milk contain the same amount of fat. If the pipette is not dry, when used, it should be filled with the milk to be tested and then thrown away before taking the sample for testing. The measuring pipette (see Fig. 9), is at once filled with milk after the mixing by sucking up the milk into it, until it reaches above the mark on the stem of the pipette. Then the forefinger, which must be dry, is quickly placed over the upper end of the pipette before the milk runs down below the mark. A little practice will be required to do this. By lightening the pressure of the finger on the end of the pipette, the milk is allowed to flow out until it just reaches the mark on the stem. If the pipette is correctly made, the quantity of milk in the pipette is just 17.6 cubic centimeters.

81. Running Milk Sample into Test Bottle.

Having the pipette containing just 17.6 c. c. of milk, we now hold the pipette obliquely, placing its point in the neck of the test bottle and the milk is allowed slowly to flow down the inside of the neck. Not a drop of milk should be lost in this operation. The portion of milk remaining in the point of the pipette is removed by blowing through the pipette before removing it from the test bottle. The pipette should never be held perpendicularly straight over the test bottle, running the milk straight down in, since the neck may choke up with milk and run over the top.

82. Adding Acid to Milk in Test Bottle.

(1.) Strength of Sulphuric Acid for Test.—The sulphuric acid to be used in the Babcock test must have a strength corresponding to a specific gravity not below 1.82 or above 1.83. If the acid is stronger, the fat in the final part of the test will be dark in color and its amount hard to read. If the acid is weaker than 1.82, there is danger of some casein remaining undissolved and this will mingle with the fat and make the test unsatisfactory. It is possible to secure good results with strong acid by using somewhat less, but it is best to purchase acid of just the right strength. The sulphuric acid should be kept in bottles tightly stoppered with glass stoppers, because it rapidly absorbs moisture and becomes too weak in time if exposed to the air.

(2.) Caution in Handling Acid.—If, in handling, sulphuric acid gets on the skin anywhere it should be immediately and thoroughly washed with abundance of water. Too great care cannot be exercised in handling this acid.

(3.) Measuring Acid and Adding to Milk.—When one has the samples of milk ready in the test bottles, then the acid measure is filled to the 17.5 c. c. mark, and from this is poured into the test bottles. The acid being much heavier than the milk sinks to the bottom of the bottle without mixing, the milk floating on top. Much care should be exercised in pouring the acid into the test bottle containing the milk. This is best done by holding the bottle in an inclined position, so that the acid will follow the inside walls down to the bottom of the test bottle and not drop through the milk in the center of the bottle; and, moreover, unless this is done, the neck is liable to choke up and cause the acid to overflow on one's hands. Failure to observe this precaution will generally cause blackening of the fat. The pouring should be slow and steady. It is well, also, while pouring in the acid, to turn the test bottle around slowly so that the acid may successively come in contact with the different portions of the inside walls of the neck and wash down any milk adhering. Unless this is done, some milk may remain in the neck, in which case its casein will be precipitated and not redissolved and thus the fat will contain particles of casein.

(4.) Mixing Milk in Test Bottle.—As soon as the acid has been measured into the test bottle, the acid and milk should be thoroughly mixed. This is best done by giving the bottle a rotary motion, with gentle shaking. Much motion up and down should be avoided, since milk may be thrown up into the neck beyond the reach of the acid and undissolved casein resulting from this will mix with the fat; and ,then, violent motion up and down might throw some of the acid out upon one's hands or clothing. When the acid and milk first mix, the casein is precipitated in a more or less solid mass, which gradually redissolves. The mixing once begun should continue until one has made certain that the casein is entirely redissolved. The chemical action of the acid upon the compounds of the milk produces much heat and, as stated above, the solution, at first yellow, changes gradually through varying shades of yellow and brown to a dark-brown color, provided the acid is not too strong. This color is due mainly to the charring or partial burning of the milk-sugar by the acid. Samples of milk that have been preserved for some time with potassium bichromate or formalin require rather more time and agitation for redissolving the casein than do samples of fresh milk.

83. Whirling Test Bottles.

(1.) Whirling the Bottles.—The test bottles containing the mixture of milk and acid should be placed in the machine and whirled directly after the acid is added. An even number of bottles should be whirled at the same time, and they should be placed in the wheel in pairs opposite to each other, so that the equilibrium of the apparatus will not be disturbed. When all of the test bottles are placed in the apparatus, the cover is placed upon the jacket, and the machine turned at the proper speed, 600 to 1,200 revolutions per minute, according to diameter of tester, for about five minutes. The test should never be made without the cover being placed upon the jacket, as this not only prevents the cooling of the bottles when they are whirled, but in case of the breakage of bottles may protect the face and eyes of the operator from injury by pieces of glass or hot acid. The machine should be frequently examined to make certain that there is no slipping of belts or frictional bearings which may cause too slow motion and result in an imperfect separation of the fat. Managed in this way no extra heat is required, as that caused by the chemical action is sufficient to keep the fat liquid. If the bottles have stood, after the acid is added, until the contents are cooled below 100 degrees F., they should be warmed to about 200 degrees F. by placing them in hot water before whirling.

(2.) Filling the Bottles with Hot Water.—As soon as the bottles have been sufficiently whirled, they should be filled only to the neck with hot water. If practical, distilled or rain water should be used for the purpose. The bottles are most conveniently filled by placing a vessel containing boiling water above the machine, and by means of a syphon made from a small rubber tube with a glass tip, run the water directly into the bottles without removing them from the wheel. The flow of water can be perfectly controlled by a pinch-cock upon the rubber tube. If only a few tests are to be made, the bottles may be easily filled with a pipette, or by pouring from a graduate. The cover should then be replaced and the machine turned for about one minute, after which the neck of each test bottle is filled with hot water to the upper limit of the scale or nearly so, and the whirling is then repeated for another minute. Unless the hot water is added in two portions, the fat is often apt to be mixed with particles of various impurities, which render the reading uncertain.

84. Measuring Amount of Fat.

After the last whirling is completed, the test bottles are removed from the machine and placed in water which has a temperature between 140 degrees and 150 degrees F. The per cent. of fat is read at this temperature. To measure the fat, hold the test bottle upright, having the graduated scale on a level with the eye; notice the divisions which mark the highest and lowest limits of the fat. The difference between gives the per cent. of fat directly. The reading can easily be taken to half divisions or to one-tenth of one per cent.

The line of division between the fat and the liquid beneath is nearly a straight line and no doubt need arise concerning the reading at this point, but, the upper surface of the fat being concave, errors often occur by reading from the wrong place. The reading should be taken at the line where the upper surface of

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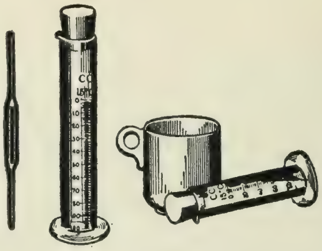

Fig. 24. Farrington's test.

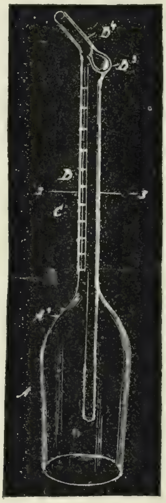

Fig. 20.

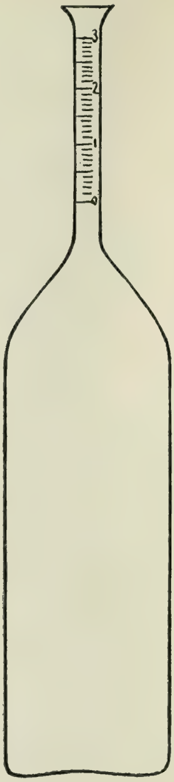

Fig. 21.

Bottles for skim-milk, whey, etc.

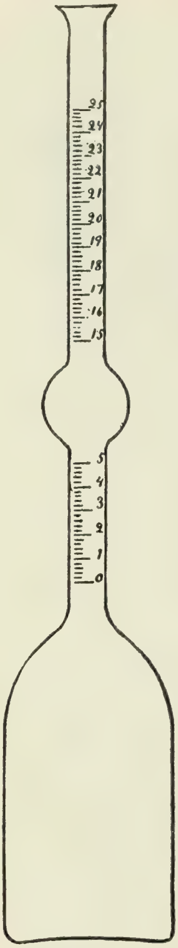

Fig. 18.

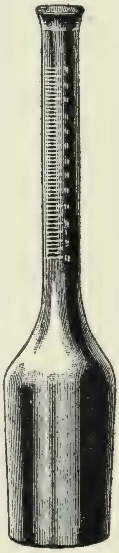

Fig. 19.

Cream bottles.

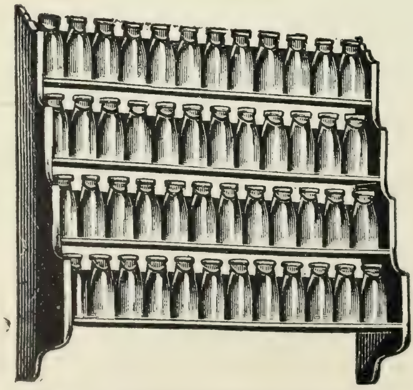

Fig. 22. Composite test sample rack.

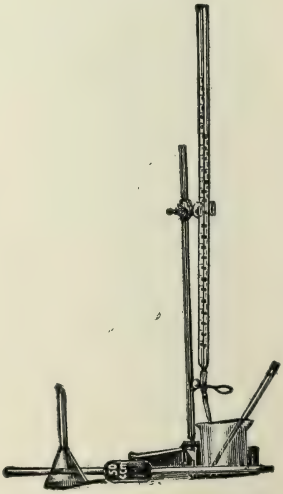

Fig. 23. Mann's

the fat meets the side of the tube and not from the surface of fat in the center of the tube nor from the bottom of the dark line caused by the refraction of the curved surface.

The reading may be made with less liability of error by measuring the length of the column of fat with a pair of dividers one point of which is placed at the bottom and the other at the upper limit of the fat. The dividers are then removed and one point being placed at the o mark of the scale on the bottle used, the other will be at the per cent. of fat in the milk examined.

Sometimes bubbles of air collect at the upper surface of the column of fat and prevent a close reading; in such cases a few drops of strong alcohol (over 90 per cent.) put into the tube on top of the column of fat, will cause the bubbles to disappear and give a sharp line between the fat and alcohol for the reading. Whenever alcohol is used for this purpose ,the reading should be taken directly after the alcohol is added, as after it has stood for a time the alcohol partially unites with the fat and increases its volume.

Whenever the fat is not quite clear, more satisfactory results may be obtained by allowing the bottles to stand until the fat has crystallized, and then warm them by placing the bottles in hot water, before taking the reading.

If the column of fat is less than about one division, as will often happen with skim-milk and buttermilk, it may assume a globular form instead of a uniform layer across the tube; when this occurs the fat can usually be estimated with sufficient accuracy by simple inspection, but in such cases it is better to use specially constructed bottles, like those illustrated in Figs. 20 and 21.

85. Testing Cream by Babcock Test.

Accurate results can be obtained by the Babcock test in ascertaining the amount of fat in cream, but much greater care has to be taken in sampling cream. Cream that is sour, or that has been exposed to air until the surface has dried, cannot be accurately sampled. The same is true of centrifugal cream that is badly frothed. Sweet cream, from Cooley cans, that is not too thick to flow readily from the pipette may be tested with satisfactory results. The process, however, must be modified slightly from that used with milk, as the amount of fat in cream is so large that it cannot be measured in the ordinary test bottle, if the usual quantity is taken for the test, besides a much greater error results from the cream which adheres to the pipette than with milk. Both of these difficulties may be overcome by taking two or three test bottles and dividing the test sample between them into as nearly equal portions as can be judged by the eye. The pipette is then filled with water and this is run into the tubes in the same way as the cream. If three bottles are taken the pipette is filled with water a second time and emptied into the bottles as before. This serves to rinse the cream from the pipette, and at the same time to dilute it to a point where it can be tested in the same way as milk. The bottles are then treated in the usual manner, and the reading of the tubes added together for the per cent. of fat in the cream. The necessity of dividing the sample of cream as directed above may be avoided by the use of the special test bottle shown in Figs. 18 and 19. Cream may also be tested in the ordinary bottles by diluting it with three times its volume of water and proceeding in exactly the same manner as with milk, the reading being multiplied by three.

Owing to the low specific gravity of cream, the test sample, if of the same volume, will weigh less than that of milk, and consequently the per cent. of fat as shown by the scale will be less than is found by gravimetric analysis, in proportion as the weight is less than 18 grms. Where a delicate balance is available, this error may be entirely avoided by weighing the cream used in a test, and calculating the per cent. of fat by multiplying the scale reading by 18, and dividing the product by the weight in grams of cream taken.

If 17.6 c. c. of cream are taken and the portion adhering to the pipette is rinsed into the test bottle, a close approximation of the true result may be obtained without weighing by correcting the scale reading as follows: For a scale-reading of 20 per cent., add 0.25 per cent.; for a scale-reading of 15 per cent., add 0.1 per per cent. Readings between these may be corrected in proportion. Below 10 per cent. no correction is necessary.

Cream may be tested in the ordinary bottles in the manner proposed by Mr. Winton, in Bulletin 108, of the Connecticut Experiment Station, by using a pipette having a capacity of 6.04 c. c., which will deliver about 6 grams of average cream or one third of the weight of the usual sample. When this pipette is used, about 12 c. c. of water should be added to the cream in the bottle before adding the acid. The usual amount of acid should be taken and the test completed in exactly the same way as with milk. The reading should be multiplied by three to obtain the per cent. of fat in the cream. No correction for the specific gravity is necessary when this pipette is used.

86. Testing Skim-Milk, Buttermilk and Whey.

With all products like the above, which usually contain less than one per cent. of fat, more accurate results are obtained by the use of a special test bottle like that in Fig. 20 or 21. Less acid is required for whey than milk.

If only traces of fat appear in the neck of the bottle, the fat in the milk examined may be nearly 0.1 per cent. and this reading will be more nearly correct than estimates of from .01 to .05 per cent., which often appear in the agricultural papers. The reason for this is that minute quantities of fat are either dissolved or not separated by the method. The amount of fat lost in this way is about the same for all milks; it is compensated for when sufficient fat is present to form a complete layer across the neck of the bottle by reading to the point where the fat meets the glass instead of at the concave surface.

87. Testing Condensed Milk.

The estimation of fat in condensed milk is accomplished in exactly the same way as with cream. As a rule, condensed milks are so thick that it is impractical to measure the test sample directly with a pipette. This difficulty may be overcome by carefully diluting the milk with a known volume of water, making the analysis of this and correcting the result for the quantity of water added. The best method is to weigh the sample into a test bottle, taking about 8 grams, and after adding about 10 c. c. of water, completing the test in the same manner as with milk, the per cent. of fat being obtained by multiplying the reading by 18 and dividing the product by the weight, in grams, of the substance taken. The results are satisfactory.

88. Testing Cheese.

The examination of cheese is not as satisfactory as that of other dairy products. The chief reason for this is the unequal distribution of moisture and fat in the cheese, making it very difficult to obtain representative samples. On account of this, tests made from different parts of the same cheese, especially if it be very rich, often vary as much as two or three per cent. in the amount of fat found. To avoid this as much as possible, samples should be taken in a uniform manner.

Where the cheese can be cut, a narrow wedge reaching from the edge to the center of the cheese, will more nearly represent the average composition of the cheese than any other sample. This may be chopped quite fine, with care to avoid evaporation of water, and the portion for analysis taken from the mixed mass. When the sample is taken with a cheese trier, a plug taken perpendicular to the surface, one-third of the distance from the edge to the center of the cheese should more nearly represent the average composition than any other. The plug should either reach entirely through or only half through the cheese. For inspection purposes, the rind may be rejected but for investigations ,where the absolute quantity of fat in the cheese is required, the rind should be included in the sample. It is well, when admissible, to take two or three plugs on different sides of the cheese and, after splitting them lengthwise with a sharp knife, take portions of each for the test.

For the estimation of fat in cheese, about 5 grams should be carefully weighed and transferred as completely as possible to a test bottle. From 12 to 15 c. c. of hot water are then added and the bottle shaken at intervals, keeping it warm, until the cheese has become softened ,and converted into a creamy emulsion. This may be greatly facilitated by the addition of a few drops of strong ammonia to the contents of the bottle. After the contents of the bottles have become cold the usual amount of acid should be added and the bottles shaken until the lumps of cheese have entirely dissolved. The bottles are then placed in the machine and whirled, the test being completed in the same manner as with milk. To obtain the per cent. of fat, the reading should be multiplied by 18 and divided by the weight, in grams, of cheese taken.

89. Testing Composite Samples at Creameries and Cheese Factories.

Provide a pint or quart fruit-jar for each patron, on which shall be a name or number distinguishing each. In each jar place about as much powdered potassium bichromate as can be held in the empty shell of a 32-oz. cartridge or about as much as one can place on a silver dime; this will keep the milk from souring. Provide a small tin cylinder holding one or two ounces of milk when filled to the brim, provided with a handle of convenient length. When a patron delivers his milk, pour it into the weighing can from a height sufficient to secure thorough mixing of the whole, and immediately, before weighing, insert the small tin cylinder, fill with milk to the brim and transfer to the fruit jar set aside for that patron's milk. In case this pouring does not mix the milk thoroughly ,then stir the milk in the weighing can with a long-handled dipper. This is repeated each day for six or seven days with the milk of each patron. Whenever a fresh sample of milk is placed in the jar, it should be mixed with the milk already in the jar by giving the jar a rotary motion. If this is not done, the cream which separates is liable to adhere tenaciously to the sides of the jar and make it difficult to take an accurate sample when the test is made. Whenever an additional sample of milk is put into a jar, it should be immediately and tightly closed. The jars should be kept in a cool place during the week. If kept too warm, the cream becomes hard and cannot readily be mixed back into the milk, which will cause low results in the test.

The quantity of potassium bichromate suggested above should be enough to keep the milk sweet for a week. In case one finds at any time that the amount does not prevent souring, then one should use more.

If milk is delivered that has firm clots of cream in it, then mix the sample in the weigh can with a dipper and take out a small portion which can be poured from one vessel to another until the clots disappear, after which take out a tin cylinder full and transfer to fruit-jar.

At the end of a week, one has in each fruit-jar a sample of milk which represents the milk delivered during that week. By testing this one sample, one secures the same results he would secure by testing the milk every day. This kind of a sample is known as a "composite sample."

90. Testing Acidity of Milk and Cream.

(1.) General Principles upon Which Acid Testing is Based.—The method of testing acidity in milk or cream is based upon the chemical action taking place between acids and alkalies. For example, if to any acid we add an alkali we change the acid and alkali both into a third compound, each of the others disappearing as acid or as alkali. Thus, suppose to some lactic acid we add some solution of caustic soda in just the right proportion, we then have neither lactic acid nor caustic soda, but a new compound formed by the union of lactic acid and sodium. To find out when a substance is acid or alkaline or neutral, that is, neither acid nor alkaline, we use some third substance, which is called an indicator. One very useful substance to use as an indicator is a chemical compound called *phenolphthalein*. When this substance is added to an alkaline solution, it turns pink, while, in an acid or neutral solution, it is colorless. For use 10 grams of phenolphthalein are dissolved in 300 c. c. of 90 per cent. alcohol, and a few drops of this are used. Now, what use can be made of these facts in ascertaining the amount of acid in milk or cream? We will illustrate: To a measured amount of cream we add some phenolphthalein as indicator, and then to this cream add some caustic soda solution, so prepared that we know just how much caustic soda it contains. We add the caustic soda, stirring the cream after each addition, until finally a pink color appears and does not go away on continued stirring. The appearance of the pink color means that enough caustic soda has been added to combine with all the lactic acid in the cream. Now, we know just how much caustic soda was required to equal the acid in the cream and from this we know the amount of acid in the cream. For dairy work, the caustic soda is prepared in such a way that a certain amount of it equals one per cent. of lactic acid. The two common forms of acid test are those devised by Mann and by Farrington.

(2.) Mann's Acid Test.—Measure exactly 50 cubic centimeters of the cream or milk into a clean porcelain cup or a glass. Add a few drops of phenolphthalein and then let in some of the "neutralizer" (Mann's name for the alkaline solution), from a burette, previously filled to the zero point. A pink color appears, but disappears on stirring. Continue to add the alkali carefully, stirring the cream or milk all the while. It will be noticed, sooner or later, that the pink color disappears more slowly after each addition of alkali. Finally, a point is reached when the pink color does not disappear even after considerable stirring. Add no more alkali. Then look at the burette and see how many cubic centimeters of alkali have been used. Suppose 30 cubic centimeters of alkali have been required to use up or equal the lactic acid in the cream, then multiply 30 by .018 and the result is 0.54, which is the per cent. of lactic acid in the cream or milk used. (See Fig. 23.)

(3.) Farrington's Alkaline Tablet Test.—In this case, the alkali and phenolphthalein are mixed together in the form of solid tablets. In using this method, one first puts five tablets into a graduated 100 cubic centimeter cylinder and fills this up with water to the 97 c. c. mark with clean soft water, distilled water if possible. The cylinder is then tightly corked and laid on its side until the tablets dissolve. The cylinder must be kept tightly corked, so that none of the solution can be lost while the tablets are dissolving. The solution will be good to use for twenty-four hours after being prepared. Solutions more than a day old should, therefore, not be used. The solid tablets will not change if kept dry. (See Fig. 24.)

In making the test, the cream or milk to be tested is thoroughly mixed and then measured into a porcelain cup with a 17.6 c. c. pipette. This pipette is rinsed once with water, and the rinsings are added to the cream in the cup. Then a few c. c. of the tablet solution prepared as above directed are poured from the cylinder into the cream and thoroughly mixed with it. The tablet solution is added in small quantities until the pink color in the cream or milk lasts for some time. Now, look at the cylinder and see how many c. c. of solution have been used. One c. c. of tablet solution stands for .01 per cent. of lactic acid. Thus, if 20 c. c. of solution are used, there is .20 per cent. of lactic acid; if 50 c. c. are used, the lactic acid is .50 per cent.

91. The Use of Lactometers in Testing Milk.

(1.) The Specific Gravity of Milk.—By the specific gravity of milk, we mean the weight of a given bulk of milk as compared with the weight of an equal bulk of water at the same temperature. For illustration, suppose we have a vat which, when just full of water, contains exactly 1,000 pounds of water. Now, if we fill such a vat full of milk, this amount of milk will weigh about 1,032 pounds, because the milk contains beside the water in it several solid substances heavier than water. Hence, we say the specific gravity of average milk is 1.032. Since the specific gravity of milk depends upon the amount of these solids in it heavier than water, then specific gravity will be found to vary, because we know that the amount of solids in milk varies considerably. So, we find some milk with specific gravity below 1.030, while that of other milk is above 1.035. The casein, albumin and milk-sugar are heavier than water. Since milk-fat is lighter than water, the more milk-fat we have in milk in proportion to the other solids, the lower is its specific gravity. By adding cream to milk, we make its specific gravity less than that of normal milk; on the other hand, by removing fat from milk, we increase the specific gravity, because we remove what it lighter and leave what is heavier than water. The addition of water to normal milk lowers the specific gravity. Thus, it is easily possible by removing cream from normal milk to increase the specific gravity and then, by adding water in right amounts lower the specific gravity back to that of the normal milk. The addition of sugar or salt to milk increases its specific gravity. Since water used to be the most common adulterant of milk, it was thought that adulteration could readily be detected by ascertaining the specific gravity.

(2.) Quevenne Lactometer.—A lactometer is an instrument used for measuring the specific gravity of milk. The Quevenne lactometer has a scale divided into 25 equal parts, going from 15 to 40. Each division is called a degree. These divisions correspond to those on an ordinary hydrometer, ranging from 1.015 to 1.040. The Quevenne lactometer is graduated so as to give correct readings at 60 degrees F. For other temperatures the reading must be corrected by adding .1 for each degree above 60 degrees F., or by substracting .1 for each degree below 60 degrees F. So, when, this lactometer is used, the milk should be at 60 degrees F., or else the correction must be made. If the

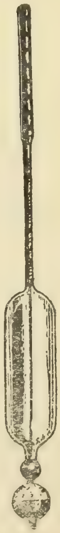

Fig. 25.

Quevenne's lactometer and thermometer combined.

Quevenne lactometer settles in milk at 60 degrees F. to the point marked 29, it means that the specific gravity is 1.029, the lowest limit allowed for normal milk. (See Fig. 25.)

(3.) Board of Health Lactometer.—Many city milk inspectors in the eastern and middle States used the so-called New York Board of Health lactometer. This does not give the specific gravity of milk directly, as does the Quevenne lactometer, but the scale is divided into 120 equal parts, the mark 100 being placed at the point to which the lactometer sinks when lowered into milk having a specific gravity of 1.029 (at 60 degrees F.), this being taken as the lowest limit of specific gravity in the case of normal milk of cows. The zero mark on the scale shows the point to which the lactometer will sink in water. The distance between these two points is divided into 100 equal parts and the scale is continued below the mark to 120; 100 degrees on the Board of Health lactometer corresponds to 29 degrees on the Quevenne lactometer, and the zero mark for both is 1, the specific gravity of water; hence, we can change the degrees on the Board of Health lactometer into degrees of the Quevenne lactometer by multiplying the readings of the Board of Health lactometer by .29. Tables are often given showing the equivalents.

(4.) Value of Lactometer in Detecting Adulterated Milk.—The value of the lactometer in detecting adulterated milk was formerly greatly overestimated. Taken by itself, the lactometer is thoroughly unreliable and misleading. Its proper use in milk inspection is simply to indicate whether a sample is suspicious and ought to be further investigated by detailed chemical analysis. As pointed out above, a milk could be both skimmed and watered and yet the lactometer would show it to be entirely normal.

(5.) Use of Lactometer in Estimating Solids of Milk.—By finding out the specific gravity and per cent. of fat in milk, it is possible, by making a few calculations, to ascertain quite closely the amount of total solids in milk and the solids-not-fat. Babcock has given useful rules for this purpose, which are as follows:

Rule 1. To find the per cent. of solids-not-fat in milk, add two-tenths of the per cent. of fat to one-fourth of the lactometer reading.

Rule 2. To find the per cent. of total solids in milk, add one and two-tenths times the per cent. of fat to one-fourth of the lactometer reading.

These rules give good results when applied to lactometer readings between 26 and 36 and to milk containing 2 to 6 per cent. of fat.

Example 1. A milk contains 4 per cent. of fat and the Quevenne lactometer reading is 32. What it the amount of total solids in the milk?

We multiply the amount of fat, 4, by 1.2; it equals 4.8. Then, we find one-fourth of the lactometer reading (32), which equals 8. Then we add 4.8 and 8 and get the result, 12.8, as the amount of total solids in milk.

CHAPTER XII.

SPECIAL DAIRY PRODUCTS.

In America most of our milk is consumed in one of the following forms: (1) Directly as milk, (2) as cream, (3) in the form of butter, and (4) in the form of cheese. To some extent, there are, in addition, special products prepared from milk for a more or less limited market. Some of these special products are finding an increasing importance in trade and others promise to become additional sources for the increased use of consumers in those special forms. In some of these special dairy products, it is easily possible for an enterprising dairyman to create a local trade.

92. Special Milk Preparations.

(1.) Blended Milk is modified normal milk, made from normal milk, (a) by adding cream or (b) by removing a limited amount of fat, or (c) by adding a limited amount of fresh skim-milk, or (d) by adding cream and skim-milk at the same time. It is a violation of the statutes of many States to sell blended milk as normal milk, except when cream has been added to normal milk. Blended milk, however prepared, is really a special preparation and should always be sold, not as normal milk, but as a special preparation with a guarantee as to its composition. The most common form of legitimate blended milk is the addition of cream to normal milk to such an extent as to bring the fat in the milk up to five per cent. The advantage of such milk is its uniformity in composition. It is usually supplied to a limited trade at higher prices than prevail for normal milk. Generally ,such milk is also prepared under every precaution of cleanliness from the stable to the delivery to the consumer. When thus prepared, it is often called "sanitary" milk, and each bottle is labeled with a guarantee of purity.

(2.) Modified Milk is milk so prepared as to make it resemble human milk in composition as nearly as possible. Such preparations are made in milk laboratories and their consumption is largely confined to cities and hospitals. Such milk should be used only by the prescription of a physician. In general, cows' milk contained more fat and sugar, and less casein, albumin and ash than human milk. The following description serves to give an idea of how such preparations are made. The milk is cooled at once after milking, its amount of fat determined, and it is then diluted with an equal bulk of boiled water. This mixture is then run through a separator. By this process the liquid coming from the cream spout can be made to give a product higher in fat in relation to casein and albumin than in the normal cows' milk and closely approximating their amounts in human milk. To 100 pounds of this product are added about two pounds of milk-sugar.

(3.) Condensed Milk is usually prepared by evaporating water from normal milk in vacuum pans to a pasty consistency. Uusually, more or less cane sugar is added to it and, when so treated, it is often called "conserved" milk. Only milk that has been carefully produced in respect to cleanliness is used for condensing. The following analyses give the composition of some condensed milks:

	Per cent. of water.	Per cent. of solids.	Per cent. of fat.	Per cent. of casein and albumin.	Per cent. of sugar.	Per cent. of ash.
Condensed milk without added sugar,	59.0	41.0	12.4	11.9	14.5	2.2
Condensed milk with added sugar,	25.6	74.4	10.4	11.8	50.0	2.2

Condensed milk is used only where fresh milk cannot be obtained, or where fresh milk is unsatisfactory in quality, and its use is, therefore, somewhat limited, but it furnishes an added outlet for the milk producer.

93. Special Varieties of Cheese.

There are made in America and Europe more than 150 different kinds of cheese. In this country most of the cheese made is the cheddar variety, but there are prepared, to a limited extent, several other kinds, some of which are successful imitations of foreign varieties of the same name. American *home-trade* cheese is usually made by the "stirred curd" or "granular" process and resembles cheddar cheese in general qualities, except that it is made to hold somewhat more moisture. *Sage* cheese is ordinary cheddar cheese containing an extract of sage leaves, imparting a characteristic flavor and light greenish color. *Pineapple* cheese is a firm, solid cheese, pressed into a shape resembling a pineapple. *American Neufchatel* cheese is a soft cheese, with a rather high water content, made from sweet normal milk; it must be consumed at once within two to four weeks after being made. It comes into market in small round forms, covered with paper and then tinfoil. *Philadelphia* cream cheese is a soft, moist cheese, somewhat resembling Neufchatel, but is made from cream and put on the market in thin, flat cakes, wrapped in parchment paper. There are also made in America, Edam, Limburger, Swiss, Brie, Camenbert, Gouda and other varieties. *Primost* or *whey* cheese is practically condensed whey, containing added cream, and pressed in the form of brick-shaped cakes. *Cheese-Food* is a form of cheese that contains all the solid constituents of milk. It is made in Wisconsin. In preparing it, an ordinary cheddar cheese is first made and cured; to about 100 pounds of this is added whey, evaporated to a syrupy consistency, from about 1,000 pounds of fresh whey. The mixture of cheese and evaporated whey is ground to a pasty consistency and pressed into cakes of convenient size. This cheese-food has good keeping quality and is very palatable, being mildly cheese-like in flavor and sweetish in taste. There are two other preparations to which more precise attention is called, because they offer to small factories and farm dairies an opportunity for working up local trade. These are cottage cheese and potted cheese, or club cheese.

(1.) *Cottage Cheese* is known under several names, such as Dutch cheese, pot-cheese, schmierkäse, etc. Much of what comes into market is poorly made; properly made, cottage cheese is a delicious and nutritious article of diet, which can be readily eaten by many people who are unable to digest other cheese. Cottage cheese is usually made from skim-milk or buttermilk. The milk is allowed to sour, this process being hastened, if desired, by keeping the milk at a temperature of 80 degrees F. until well coagulated. If allowed to stand too long, the curd is likely to become soft and mushy in consistency and too sour in flavor, resulting in an unsatisfactory product. When well coagulated, the temperature is gradually raised and the coagulated mass is stirred, thus breaking the curd into small pieces, from which moisture is more readily expelled. The temperature is gradually raised to 120 degrees F. and the stirring is continued. When the curd is sufficiently firm, it is allowed to settle. Then the whey is removed and the curd dipped into a cloth strainer that can be suspended, and the excess of whey is allowed to drain from the curd, the process being facilitated by occasional stirring. After becoming sufficiently dry, the curd is salted to taste, and, if a desirable article is to be made, it should have mixed into it a little cream or melted butter. It can be put up in various forms for the market, the chief requirement being that it shall have an attractive appearance.

A cottage cheese of less acid character can be made by taking milk that is only mildly sour and using a little rennet extract to hasten the coagulation. In this case the temperature used in expelling the whey need not be so high.

(2.) *Potted Cheese, or Club Cheese.*—This is on the market under various brand names, such as Club House, Canadian Club, Meadow Sweet, etc., being put up in small jars. This cheese is very easily prepared on a small scale. Take a piece of any good well-ripened cheese, pare off the rind, cut the cheese into small chunks and pass them through a meat-grinding machine. To the cheese thus ground, one adds one ounce of melted butter of good quality for each pound of cheese and works it through the cheese until thoroughly incorporated. Then take small jars or jelly glasses, cover the inside with a layer of melted butter and pack into them the cheese, filling nearly level full. Then cover the exposed surface with melted butter and put over this a cover of paper. Set away in a cool place until wanted for use. The writer knows of cases where small dairy farms make cheese and put the product on to the local market in this form with great success. Any housekeeper can easily put up cheese in this way. Cheese put up in this way has, for the consumer, several advantages, since it does not dry out before being used up, is in convenient form to set directly on the table, is exceedingly palatable and is soft enough to be spread on bread or crackers, if desired.

94. Special Dairy Beverages.

The value of whole-milk, of skim-milk and of buttermilk as beverages has been long well known, supplying, as they do, readily digestible nutrition and quenching thirst, at the same time. There is one preparation of milk which deserves more attention as a common beverage that it has received, and that is koumiss, prepared from cows' milk. Its use is now largely confined to invalids, but it is a most desirable beverage for well people. In no form of preparation does milk seem so easily digestible, even in weak stomachs, as in the form of koumiss. People can drink *koumiss*, who can not use ordinary milk. It can be easily prepared in any household and any dairyman could work up a good local trade in it, after once getting a start. Many people do not like koumiss at first, but readily acquire a taste for it and become exceedingly fond of it. A good article of koumiss can be prepared, on a small scale, as follows: To three quarts of fresh milk, add three level tablespoonfuls of ordinary granulated sugar and one fresh compressed yeast cake (Fleischmann's), or an equivalent of any other form of yeast. Stir it thoroughly and warm the milk up to 100 degrees F. to 105 degrees F., and keep it at that temperature, stirring from time to time, until the yeast begins to work, which is shown by little bubbles of gas escaping from the surface of the milk. This may require from three to five hours, according to the activity of the yeast. When the yeast is working well, pour the milk into pint beer bottles or some similar bottle that will stand pressure and has a convenient arrangement for corking. Fill the bottles only two-thirds full. Then put in stoppers and place the bottles in a warm place at 90 degrees F. to 100 degrees F. for half an hour. Then place at once in a cold refrigerator or directly on ice, laying the bottles down on their sides. In twenty-four hours, the koumiss is ready to begin to use. If one have good yeast and keeps the temperature at 100 degrees F., there should be no trouble in making excellent koumiss. Koumiss a week old is usually too acid for the taste of some people. In opening a bottle of koumiss after it is one or two days old, it is well to perform the operation in the kitchen rather than in the dining room, since there is usually such a pressure of accumulated gas in the milk that it may come out with a rush, especially if the contents of the bottle have been shaken just before opening. Milk from which half the fat has been removed or fresh separator skim-milk makes good koumiss.

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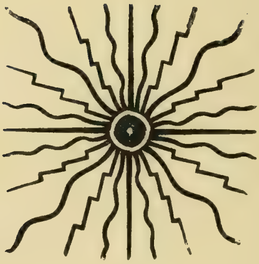

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